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THE STATUS REPORT ON THE NPOESS WEATHER SATELLITE PROGRAM

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

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THE STATUS REPORT ON THE NPOESS WEATHER SATELLITE PROGRAM

THURSDAY, JUNE 7, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 1:00 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
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Subcommittee on Energy and the Environment

Hearing on

The Status Report on the NPOESS Weather Satellite Program

Thursday, June 7, 2007
1:00 - 3:00 P.M.
2318 Rayburn House Office Building

Witnesses

Hon. John Marburger III
Director, Office of Science and Technology Policy

Mr. David Powner
Director, Information Technology Management Issues
Government Accountability Office

Brigadier General Sue Mashiko
United States Air Force, Program Executive Officer for Environmental Monitoring

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

The Status Report on the NPOESS Weather Satellite Program

THURSDAY, JUNE 7, 2007
1:00 P.M.–3:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

The Subcommittee on Energy and Environment meets on June 7, 2007, to continue oversight on the unsettled National Polar-Orbiting Operational Environmental Satellite System (NPOESS). The Government Accountability Office (GAO) will release the latest report on this critical weather monitoring platform requested by the Subcommittee, and the Program Executive Officer for NPOESS will respond to the findings and recommendations. Additionally, the Director of the Office of Science and Technology Policy (OSTP) will respond to questions about the status of sensors for tracking climate and so-called "space weather" phenomena that were removed during the recent program restructuring.

Witnesses

Mr. David Powner, Director, Information Technology Management Issues, Government Accountability Office: Mr. Powner is the head of the GAO team continuously monitoring the NPOESS program since 2001. He will present their latest report that discusses the effort to strengthen the management of the NPOESS program and evaluates the realistic cost estimate for the revised program. The report also examines the continuing risks that challenge the execution of the program.

Brigadier General Sue Mashiko, USAF; Program Executive Officer for Environmental Monitoring: General Mashiko has been in the post of Program Executive Officer for the NPOESS program since November 2005. The position was established in the wake of the program's restructuring to evaluate the performance of the Integrated Program Office (IPO) handling the system acquisition and to serve as the arbiter for awarding performance incentives to Northrop Grumman, the program's contractor. General Mashiko also took on the responsibility for external relations with the Executive Committee comprising the heads of the three agencies (NOAA, the Air Force and NASA) contributing to the program.

Hon. John Marburger, III, Director, Office of Science and Technology Policy: OSTP has been managing reviews by NASA and NOAA of the sensors removed from NPOESS to identify other ways to fly the instruments and maintain the data sets. Dr. Marburger will discuss the process involved in these reviews, the results to date, and how these reviews will determine the alternative plan for preserving climate and space weather observations.

Background

A Short History of NPOESS

For decades, the United States has maintained satellites in orbit, looking down at Earth and gathering information that allows us to track and forecast weather. These satellites operated in both geostationary orbit (where they move fast enough to keep pace with Earth's rotation, thus staying in the same place above the equator and seeing an entire hemisphere at once) and in polar orbits (allowing them to pass over all points on Earth as the planet rotated underneath). Both the Air Force and NOAA were operating polar satellites to satisfy their diverse user needs. In 1993, the decision was made to combine both programs into a single system, and thus the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) was born.

In 2000, the NPOESS program anticipated purchasing **six satellites** for **$6.5 billion,** with a **first launch in 2008.** Following financial problems, a new program baseline was issued in 2004, which raised the expected **acquisition cost to $7.4 billion.** By November 2005, the program office determined that it was likely that NPOESS would run over that estimate by at least 25 percent, which triggered the Nunn-McCurdy review by the Department of Defense. In order to continue the program, it was necessary to report to Congress that:

- The program is essential to national security;
- No alternative program provides the same or improved military capability at lower cost;
- The new cost estimates are reasonable; and
- The program's management is adequate to manage and control costs.

The NPOESS Program was recertified on June 5, 2006, but there were some significant changes. The estimate for **acquisition cost rose to $11.5 billion** (and, as GAO notes in its report, there is an additional $1 billion to cover operating costs, making the **total life cycle cost $12.5 billion**). Only **four satellites** will be built, with the **first launch now scheduled for 2013.** A major sensor, the Conical Microwave Imaging Sounder (CMIS), was removed because it seemed unlikely that the technical issues in its design and construction could be overcome. A new competition is to be conducted for an instrument whose capabilities will fall much closer to existing technology. The U.S. would fly satellites in only two, not three, polar orbits; data from the third orbit would now be the responsibility of European satellites.

The other major decision was to remove several sensors. Some would focus on the study of Earth's climate. Others monitor phenomena generated by the Sun that affect the Earth's magnetic field and can play havoc with power lines, airline flights over the polar regions and satellites. Scientists studying climate were particularly concerned. Detecting the small changes in the ocean and atmosphere that signal climate changes is critically dependent on data collections that cover decades in time. Without the climate sensors on NPOESS, some of the most basic climate data would no longer be available. This has been the focus of articles that appeared in the last day regarding the NPOESS program and the loss of climate sensors from the satellites.

Central to the persistent problems in the NPOESS programs are the major sensors and the program's management. The cancellation of CMIS came about because the weight and size kept growing as the Boeing instrument team struggled to meet Army requirements for determining soil moisture. Even worse was the Visible/Infrared Imager Radiometer Suite (VIIRS), where sub-component deliveries were behind schedule, testing of various items was harder and took longer than expected, ground support equipment was not working properly, and independent reviews of Raytheon management resulted in removal of the entire instrument management team. VIIRS is the primary instrument on NPOESS; it will contribute data to more of the expected products than any other sensor. The Integrated Program Office, lacking sufficient reserves, attempted to deal with the problems by redeploying resources from the other instrument contracts, upsetting their performance. Last year, the Cross-Track Infrared Sounder (CrIS) suffered a broken frame during its vibration testing. The program has since been checking the various pieces of the test instrument to learn if they can still be used. NPOESS managers believe that the second frame can be substituted for the first, minimizing disruption to the program.

The Committee's hearing in November 2005 on the NPOESS program examined the poor performance of NPOESS management levels. This extended all the way from subcontractors (as noted in the case of VIIRS) to the Executive Committee (EXCOM), which comprises senior leaders of the three agencies involved in the program. Members questioned why the EXCOM failed to meet as the NPOESS program spiraled further into crisis. Repeated analysis of alternatives often substituted for decisions. By August 2005, the head of NOAA declared he had no confidence in the information being reported by the Integrated Program Office. Part of the program change instituted by the Nunn-McCurdy process was the redesign of the management structure. General Mashiko became responsible for seeking direction from the EXCOM and assuring that those decisions were executed by the IPO. The IPO also began hiring the technical and managerial talent needed to fill the many gaps that left it unaware of problems or unable to respond to them. The EXCOM has been holding quarterly meetings on the program. For the moment, at least, turmoil in the management suites is not a primary contributor to risk in the NPOESS program.

Climate Change Science and the White Paper on De-manifested Sensors

NPOESS satellites, as originally designed, were to do more than support weather forecasting needs for NOAA and the military services. Sensors were also included to expand the type of climate data being collected by NASA's Earth Observing System satellites, and to provide insight into the effects on Earth's environment from solar activity. These sensors were removed in the Nunn-McCurdy process. The loss of these sensors was met with dismay among the affected user communities. The National Research Council, which was completing its first Earth science decadal survey, recommended immediate efforts to restore some of the sensors to NPOESS. On June 26, 2006, OSTP met with NASA and NOAA to discuss a response. NASA agreed to develop an analysis of the consequences of the removal of climate sensors.

NASA issued its first draft on August 15, 2006. NOAA added its contributions in drafts that were completed in December 2006. The final version of the white paper was delivered to OSTP on January 8, 2007.

In the paper, NASA and NOAA conclude that, "Unfortunately, the recent loss of climate sensors due to the NPOESS Nunn-McCurdy Certification places the overall climate program in serious jeopardy." In the August 15 draft, NASA devised a set of recommended actions for the canceled sensors. The main difference between the first draft and final version was the development of a priority listing.

The white paper lists its first priorities as the Total Solar Irradiance Sensor (TSIS) and the Earth Radiation Budget Sensor (ERBS). Together, these sensors track the amount of energy the Sun imparts to the Earth, and how much of that energy the Earth reflects from its surface, clouds and what is not absorbed by greenhouse gases. The difference between the values reported by these two sensors is a critical starting point for evaluating climate effects. TSIS data extends back over 28 years, and any loss would disrupt our understanding of the "dominant, direct energy input into terrestrial ecosystems."

NASA will fly part of the TSIS instrument on its *Glory* mission, currently scheduled to launch in December 2008. It will be a three-year mission, with hopes of two more beyond that. The white paper recommends three TSIS sensors, with the first to be launched on any available and suitable vehicle in time to overlap with the *Glory* mission. For ERBS, the possibility of a data gap between the end of the current *Aqua* mission and the launch of the first NPOESS mission leads to a recommendation that the last Clouds and Earth's Radiant Energy System (CERES) sensor be flown on NPP, rather than wait for NPOESS. ERBS would then be flown aboard the first and third NPOESS missions. The Decadal Survey agreed that these sensors "should be restored on NPOESS or provided by other means to avoid a measurement gap in the timeframe 2008 to 2012."

Fourth in the white paper priority list was the limb-scattering component of the Ozone Monitoring and Profiling Suite (OMPS–Limb). The decision to remove this particular sensor came at a point where the hardware had been completed and would have required a significant effort to decouple from the other part of the instrument. Since the cost of completing the instrument was not that much different from removing it, the NPOESS program decided that a full OMPS should be flown on NPP as originally planned. It remains uncertain if the full OMPS sensor will fly on NPOESS missions.

Of concern as this analytical process unfolds is its tenuous integration with the NPOESS program and the possibility that it will be overtaken by events. This first came to the Committee's attention in March when the instrument contractor indicated that if the OMPS–Limb sensor was to be flown on NPP, a decision had to be made by the end of that month to preserve the September 2009 launch date. Senior Members of the Committee wrote to Dr. Marburger, NASA Administrator Michael Griffin, and NOAA Administrator Conrad Lautenbacher to take advantage of the opportunity.

Testifying before the Committee a year ago, Admiral Lautenbacher stated:

> We specifically decided that the NPOESS spacecraft will be built with the capacity to house all of the [de-manifested] sensors, and includes funding to integrate them on the spacecraft. The decision was made because the EXCOM agreed that any additional funding gain through contract renegotiation or in unutilized management reserve would be considered to procure these secondary sensors, in addition to other organizations bringing money for these sensors to the table.

Indeed, the white paper recommends taking advantage of this capability. Yet the drafters of the analysis indicated in a briefing to staff on May 17 that they learned the NPOESS program office would not accept any additions to the sensor complement on the first NPOESS satellite. Indeed, according to a briefing chart for the March 2, 2007 EXCOM meeting, the "Lock-Down Dates for integration of De-manifested Sensors” on the first satellite was already past. Yet the white paper was delivered still recommending efforts to fly some sensors on the 2013 launch.

The EXCOM briefing chart states that “C–1 requires significant additional development, integration and test time for sensors and spacecraft,” and General Mashiko indicates that the NPOESS program made the decision to freeze the sensor complement to reduce risk of disruption. Yet these sensors were originally manifested aboard the satellite, and as Admiral Lautenbacher testified, the program was directed to maintain space and funding to accommodate them. The interfaces between sensors and satellite are already included in the requirements and specifications. While space on the first launch is not an issue for TSIS, it was an option for ERBS, OMPS–Limb and the Advanced Polarimetry Sensor. Is it indeed the case that there are no chances to fill up some of those available slots aboard the first NPOESS satellite?

In contrast to the decision to restrict further changes to the first NPOESS satellite, the decision to add CERES to NPP is still open. Now just two years from launch, making yet another change to the complement of instruments raises the risk calculations. Arguing in favor of the change is that it would reduce the threat of data loss, and that the contractor is willing to offer a fixed-price proposal to do the job. The government rarely receives such offers unless the bidder is truly confident that the task is completely understood.

Of more immediate concern for TSIS is the possible loss of the contractor’s staff before the OSTP process reaches a conclusion on the sensor. With the decision to terminate TSIS, the University of Colorado’s Laboratory for Atmospheric and Space Physics (LASP) has been dealing with the possibility that the employees on the project would disperse. LASP has proposed a follow-on mission that would update the technology now flying on the SOlar Radiation and Climate Experiment (SORCE) spacecraft with TSIS. This would bridge the gap between *Glory* and another TSIS that would be placed aboard the second NPOESS satellite in 2016. This would be consistent with the white paper’s recommendation, but hard to execute if the sensor’s builders have gone on to new jobs.

A similar situation may exist in the sensor for monitoring the effects from solar flares and coronal mass ejections—so-called “space weather” phenomena. Power companies, airlines and satellite operators have all discovered in recent decades that the energetic particles and plasmas can disrupt critical infrastructures or increase their costs. NOAA’s ability to provide early warning of these events, particularly as the Sun enters the more active phases of its 11-year cycle, has been improving in tandem with higher-capability sensors.

NPOESS was slated to carry the Space Environment Sensor Suite (SESS), a combination of five types of instruments that collected data on different aspects of the particles and fields involved in space weather. As a result of the Nunn-McCurdy decision, these were replaced with the Space Environment Monitor (SEM) instrument now aboard existing satellites. One of these instruments is the Thermal Plasma Sensor (TPS). It was designed to provide data on the geomagnetic and electric fields and plasma temperatures and fluctuations during solar events. With such information, the Air Force could quickly evaluate the loss of function in their satellites to determine if it was the result of a natural event or some adversary’s action. In times of crisis, this would be an extremely time-critical analysis. Massive events in October and November of 2003 and again in December 2006 affected oil drilling in the Gulf of Mexico as the GPS signals that precisely locate drilling platforms above the tangle of sea floor pipelines were lost for up to fifteen minutes.

The United States has only one manufacturer for TPS sensors, a university group at the University of Texas at Dallas (UTD). The university anticipates that the group will disband as there is no other existing requirement for these detectors. Some of the UTD groups are expected to retire and the lack of interesting projects is likely to cause the remainder of the team to seek other opportunities. The SEM package will not meet the requirements assigned to the TPS sensor, and yet we may lose the capability to obtain such instruments in the next few months. OSTP only initiated the effort to conduct an analysis of the Nunn-McCurdy impact on the space environment sensors in February, and there is nothing similar to the climate sensor white paper yet available.

In its original white paper draft last August, NASA stated, “The budgets and schedules associated with these recommendations will be incorporated in a subsequent draft of this white paper to be available in approximately one month.” Staff was told in the May 17 meeting that the authors “were a bit optimistic” about their ability to provide such information. A month after the white paper was delivered, OSTP asked the agencies to begin a second study that would incorporate budget requirements and alternatives to replacing the sensors on the NPOESS satellites. The National Research Council was asked to convene an additional panel to provide assistance. However, the agencies are not anticipating a final report to OSTP before September, and that may only include interim information from the Research Council. While Office of Management and Budget representatives are attending OSTP's meetings to obtain updates on the analysis, there does not seem to be any discussion about required budget actions.

Members of the Decadal Survey recommended that "OSTP. . .should develop and implement a plan for achieving and sustaining global Earth observations." This experience raises the possibility that OSTP may not be ready to take on that more ambitious task.

GAO's New Report

The Committee first asked the Government Accountability Office to evaluate the NPOESS program in 2002, when concerns about NOAA's ability to handle the data volume expected from the satellites was at issue. In 2004, it reported that costs had jumped by $1 billion and that launch dates for the various satellites were slipping. In November 2005, Mr. Powner stated that cost and schedule trends were continuing to deteriorate and called NPOESS "a program in crisis." In this report, GAO focuses on the state of the NPOESS program as it starts to carry out the decisions made by the Nunn-McCurdy process.

GAO notes that the program managers have succeeded in imposing greater discipline on the program. The program managed to achieve 156 of 166 milestones in the interim program plan for fiscal year 2006, and has since addressed five of the residual items. Through January of 2007, the program had reached 62 of the 222 milestones planned for fiscal year 2007—two more than planned. In a briefing to staff, Mr. Powner stated that the IPO maintains that NPP will meet its 2009 launch date and that the program cost estimate remains $12.5 billion. He said, though, that NPP will launch "as-is" (with instrument performance at whatever level can be achieved by launch day) and that there are still cost pressures that may push the estimate above $12.5 billion.

a. Acquisition planning documents

In April, when it delivered its report, GAO noted that major documents necessary for the development of program plans and renegotiation of the contract with lead contractor Northrop Grumman are still awaiting approval. These included:

- the reworked Memorandum of Agreement defining roles and responsibilities for NOAA, the Air Force and NASA;
- the system engineering plan;
- the test and evaluation master plan; and
- the acquisition strategy.

According to the decision memorandum that resulted from the Nunn-McCurdy process, the Memorandum of Agreement should have been completed August 6, 2006 and the other documents by September 1, 2006. These documents define the relationships between the Integrated Program Office and the agencies and lay out the predicted levels of resources in terms of time, money and effort that will be required to complete the NPOESS program in the wake of the Nunn-McCurdy recertification. The information in these documents will govern the budget requests for NPOESS from NOAA, the Air Force and NASA for years to come. That it has taken a year to complete these items, even though they should be little more than recording the hard choices already taken in the Nunn-McCurdy process, indicates that interagency coordination still serves to weigh down the program.

GAO recommended in the report that the agencies have the approvals completed by April 30. Yet in meetings with the Committee staff May 23 and 25, both GAO and General Mashiko indicated these documents still awaited signature. The agency comments included in the report indicate that the Department of Defense's process for approving the interagency Memorandum of Agreement appears to be the major roadblock, as NOAA and NASA could not complete approvals until there was a final consensus on the text to be approved.

From General Mashiko's perspective, some documents are more important than others. She emphasized that the program office prioritized development and completion of the integrated master schedule and the integrated master plan. These, she said, were the prime tools for the program office's day-to-day activities and are the primary tools for the government's control of contractor activities. These documents are now developed to a point well beyond what the government previously had available and, according to Colonel David Stockton (the NPOESS Program Director), give him greater ability to measure actual performance by Northrop Grumman and the instrument manufacturers. These two documents should be in final form before completion of the contract renegotiation, because changes after that point will result in contract modifications. Such modifications rarely result in lower costs to the government.

b. Program Office management and staffing

GAO next moved to a discussion of program leadership and program office staffing. In July, General Mashiko will be transferred by the Air Force to the MILSATCOM program. GAO recommends that the Air Force delay the transfer until July 2008, when all of the instruments scheduled to fly on the NPP mission have been delivered. Before that point, GAO considers the increase in risk from management disruption "unnecessary." That recommendation has been rejected by DOD.

General Mashiko stated to staff that change in her position is less significant to progress in NPOESS than would be the case if the System Program Director, Colonel Dan Stockton, was to depart. The EXCOM met May 21 to discuss the transition. According to the comments in the report, NOAA was expecting to supply the next Program Executive Officer; apparently the deadline in the position announcement had to be extended two weeks to attract candidates. General Mashiko indicated eight are now being considered. The Air Force will supply a deputy. The intent is to select the replacement quickly to allow as much time as possible to hand over responsibilities and to allow the new Executive Officer to participate in decision-making.

GAO argues in its report that management turnover is a contributing factor to the problems that have disrupted many other Air Force space system procurements. They believe senior managers should serve until completion of development or actual delivery of their product, not simply an arbitrary period of time. The former Chairman and CEO of the Lockheed Martin Corporation, Norm Augustine, wrote in his book *Augustine's Laws* about the problems that come from ". . .attempting to develop major new systems with ten-year technology, eight-year programs, a five-year plan, three-year people, and one-year dollars." GAO has lost the argument on this recommendation, but this now becomes another issue that the Committee will have to watch carefully as the new leadership takes over.

GAO also recommended that NOAA needed to develop plans for identifying the staffing needs in the NPOESS program office and to initiate steps to fill vacant critical slots. The lack of systems engineering personnel and budget and cost analysts in the Program Office has been a consistent concern of independent reviewers. As of April, GAO found that five budget analyst positions and 15 system engineering or technical manager positions remained unfilled; 16 were to be provided by NOAA. That these positions remained open a year after the Nunn-McCurdy decision directive ordered expedited actions to fill vacant positions led GAO to express concern about the government's ability to develop an updated cost estimate for renegotiating the contract with Northrop Grumman or to handle management tasks.

General Mashiko stated in her staff interview that staffing actions had accelerated with the hiring of a personnel specialist with the ability to assist division managers in identifying staffing needs. The Program Office also received assistance from the human resource offices at the three agencies to find candidates with particular skills and see them assigned to NPOESS positions. General Mashiko indicated that there are now only six of NOAA's 16 slots still open, and those were in various stages of recruitment. Some positions had to be re-advertised to identify candidates with appropriate skills. That NPOESS is competing with every other R&D agency in the government for these skill sets also slowed the process.

c. Continuing concerns

As noted earlier, the sensors for NPOESS remain the major concern in successfully executing both the early NPP mission and the operational NPOESS program. The VIIRS instrument was the subject of extensive discussion at the EXCOM meeting of March 2, 2007. This so-called "Gate 8" decision required the instrument team to demonstrate that it had addressed design issues and that the instrument would perform as expected. According to the briefing slides, assuming that the flight unit performed as well as the current engineering development unit, the data would meet or exceed what is now provided by existing satellites. However, there was one issue—"optical crosstalk"—that remained open. It threatened to reduce ocean color measurements below the lower limit of the specification. If NOAA decided to buy a new filter from a different manufacturer, it might slip the delivery schedule. The EXCOM decided to accept the recommendation to continue forward with VIIRS development while continuing to seek a solution to the crosstalk issue. General Mashiko indicated to the staff that VIIRS delivery for the NPP mission is still scheduled for late May next year, and there remains three months of margin in that schedule.

The Failure Review Board for the CrIS flight unit vibration test mishap believes an incorrect structural analysis of the instrument frame led to an overestimate of the frame's strength. The subassemblies are being tested to see if they suffered damage; particularly the interferometer, which is the primary sensor element. The IPO has already begun to build a second interferometer to minimize disruption if the first is unusable. The frame for the second flight unit will be used in the first instrument (the fixes defined by the failure analysis "will not be pretty" but they will work, according to Col. Stockton). The government technical team independently analyzed and approved the frame changes. Delivery of this unit slipped from December 2007 to February 2008; three months of margin still remains.

Loss of the CMIS sensor affected two important data items. CMIS was the prime contributor to the measurement of soil moisture, critical to the Army as it determines whether heavy equipment can operate in a particular region. Requirements for collecting data on ocean winds were also to be met with CMIS data, which factors into recent concerns about the possible loss of the QUIKScat scatterometer and the resulting impact on hurricane forecasting. In the Nunn-McCurdy decision memorandum, the NPOESS program was directed to initiate a new microwave imaging sounder that would provide an instrument at least as capable as current technology in time to fly on the second NPOESS satellite in 2016. General Mashiko stated that the specifications for this new sensor have been developed, and that the program office is consulting the user community. The Program Office hopes to have a recommendation for Mashiko's replacement as Executive Officer in September in order to obtain EXCOM approval by January 2008.

GAO notes in its report that during 2006 spending for NPOESS space items exceeded the cost target by $17 million (a four percent overrun of the planned budget for the year). Further, the contractor could not complete $14.6 million planned during the year. The problems with the VIIRS and CrIS instruments were the major factors. These negative trends are likely to persist as the testing programs on the instruments progress. GAO states that these issues may affect the life-cycle cost estimate.

There may also be impacts on the cost estimate from the contract modification negotiations now underway. Schedule milestones will be the primary criteria in award fee determinations, and the award fees will be small. Northrop Grumman delivered its proposals for the contract modification May 7. General Mashiko intends to have the new contract signed before she leaves.

GAO concludes that "restructuring is well under way, and the program has made progress in establishing an effective management structure." There has not been enough progress to show that the key technical risks which have bedeviled the program are being reduced, however. VIIRS flight hardware has yet to be built, and CrIS flight hardware suffered an unexpected failure in early testing. General Mashiko will not dispute that assessment but argues that the steps taken by the new program management give greater confidence that we have an accurate understanding of the risks and a realistic plan to deal with them. GAO has already accepted a request from the Committee to continue its independent evaluation as execution of the restructured program advances.

Chairman LAMPSON. This hearing will come to order, and I want to wish all of you a good afternoon. Welcome to this hearing on the National Polar-Orbiting Operational Environmental Satellite System, NPOESS. These satellites are the next generation of observational platforms that will allow the National Oceanic and Atmospheric Administration and the Department of Defense to provide weather forecasting services. It is not too much to say that the United States cannot get along without them.

And this is not the first hearing the Committee has held on NPOESS, and I am confident in saying that it won't be the last. This has been an area of strong bipartisan concern for several years. When I left Congress in January of '05 (not by choice) this committee was already concerned about performance trends in the NPOESS program. The Government Accountability Office had reported to this subcommittee in September, '04[1], that a significant increase in the cost estimate had occurred, there were technical problems with the instruments, and there was strong evidence that there would be a half-billion-dollar cost overrun at the end of the program.

Just over a year later, Mr. Powner has testified in a hearing here that cost and schedule trends had worsened and said that the program was in crisis.[2] Soon after that testimony, Congress received notification that there was good cause to believe NPOESS would exceed its acquisition baseline cost by more than 25 percent—by more than the 25 percent needed to trigger a re-certification of the program under the Nunn-McCurdy provisions of federal procurement law.[3]

Today's hearing marks the first time for the Committee to get a sense of how the post-Nunn-McCurdy NPOESS program is faring. Nunn-McCurdy decisions at the Department of Defense have established a track record of more expensive acquisitions for fewer satellites. Perhaps most critically, the re-certified program now lacks most of the climate sensors that were to fly on NPOESS and were to form the heart of our instrumentation to provide data for tracking global warming.

The Office of Science and Technology Policy started an effort to deal with the climate sensors lost for NPOESS almost immediately after the announcement of the Nunn-McCurdy decision. Dr. John Marburger is joining us today to explain that process.

My concern is that the effort headed by OSTP, with analytical support from NASA and NOAA, is lagging the pace needed to make effective decisions. The directions to the agencies are to look at all options for every data need rather than a direction to identify money that could be used to fund the planned instruments that had been de-manifested. You can study that problem and all possible options for as long as you want, but at some point the manifests for what will fly on the NPOESS satellites have to be finalized, and so decisions are not just due. I believe they are overdue.

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[1] *Polar-Orbiting Environmental Satellites: Information on Program Cost and Schedule Changes,* Government Accountability Office Report GAO–04–1054; September 30, 2004.

[2] U.S. House of Representatives Committee on Science. *Ongoing Problems and Future Plans for NOAA's Weather Satellites.* Hearing before the Committee on Science. Serial No. 109–33; November 16, 2005.

[3] 10 U.S.C. 2433, *et seq.*

I think that without decisive action and leadership, we will lose continuity in the multi-decadal data sets that are sensitive—that are central to our understanding of global warming. In fact, some breaches in data collection may be unavoidable at this point. There was time, just time to add money into the 2008 budget request if the interagency exercise had been pushed harder last summer. Now, one year later, the problem is still under study, and it may be that answers won't come before the 2009 budget is finalized.

As to money, I think that NASA and NOAA may not be able to do what needs to be done without direct intervention from the White House to give them the added resources necessary to fund those instruments. The President just delivered another major address on climate change. Perhaps one step he could take towards showing other nations that this proposal is a serious one would be to identify funds to find and to fly the climate sensors.

We will also hear today from David Powner of GAO. Mr. Powner is a frequent witness before this committee. His testimony today is less dramatic than at some other times, prior appearances. At this moment in time the NPOESS program does not appear to be losing further ground.

According to GAO's report, the ground systems for NPOESS data handling are now running under their budget, and they have achieved more than they had planned to accomplish at this point. Such performances are so rare it may be that particular project manager deserves the Congressional Gold Medal.

Unfortunately, that performance is overshadowed by the continuing risks we see with the major instruments destined to fly on these satellites. Both the VIIRS[4] and CrIS[5] instruments still show significant engineering challenges. There is little doubt that the challenges can be overcome, but the risk attaches to how much time and money the fixes will cost.

There are still a lot of tests for NPOESS to get through, which means there are many opportunities for unexpected events to upset the program. So we have asked Mr. Powner to keep up the good work.

Air Force Brigadier General Susan Mashiko is also with us today, and in the 20 months that she served as Program Executive Officer for NPOESS, she has restored a semblance of order in management structure, to the management structure. Indeed, the announcement of her imminent rotation to another posting led GAO to recommend to the Air Force that she not be spared just yet. I think that the Air Force is going to ignore that advice, but it may be to the detriment of the program if solid management is not put into place immediately. NPOESS is not a program that can be allowed to drift along.

We are a year beyond the Nunn-McCurdy de-manifestation—de-manifesting of both climate science and space weather instruments—and yet no decisions have been made on how to proceed.

We are a year beyond Nunn-McCurdy with the same instruments causing us the same concerns about risk.

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[4] VIIRS: Visible-Infrared Imaging Radiometer Suite

[5] CrIS: Cross-Track Infrared Sounder

General Mashiko is a month away from her transfer and no replacement has been named.

I think progress has been made in managing the downsized NPOESS program that the Department of Defense brought us, but not enough progress to reduce our concerns about the future for this satellite program or to satisfy our need to see our climate science efforts fully supported.

I want to thank all for you for coming, and I will now recognize the Ranking Member, Mr. Inglis, for his opening remarks.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

Good afternoon, welcome to this hearing on the National Polar-Orbiting Operational Environmental Satellite System (NPOESS). These satellites are the next generation of observational platforms that will allow the National Oceanic and Atmospheric Administration and the Department of Defense to provide weather forecasting services. It is not too much to say that the United States cannot get along without them.

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Today's hearing marks the first time for the Committee to get a sense of how the post-Nunn-McCurdy NPOESS program is faring. Nunn-McCurdy decisions at the Department of Defense have established a track record of more expensive acquisitions for fewer satellites.

Perhaps most critically, the recertified program now lacks most of the climate sensors that were to fly on NPOESS and were to form the heart of our instrumentation to provide data for tracking global warming.

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You can study that problem and all possible options for as long as you want, but at some point, the manifests for what will fly on the NPOESS satellites have to be finalized, and so decisions are not just due, I believe they are overdue.

I think that without decisive action and leadership, we will lose continuity in the multi-decadal data sets that are central to our understanding of global warming. In fact, some breaches in data collection may be unavoidable at this point.

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I think the Air Force is going to ignore that advice, but it may be to the detriment of the program if solid management is not put in place immediately. NPOESS is not a program that can be allowed to drift along.

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We are a year beyond Nunn-McCurdy with the same instruments causing us some of the same concerns about risk.

General Mashiko is a month away from her transfer and no replacement has been named.

I think progress has been made in managing the downsized NPOESS program that the Department of Defense brought us, but not enough progress to reduce our concerns about the future for this satellite program or to satisfy our need to see our climate science efforts fully supported.

Mr. INGLIS. Good afternoon, and thank you, Mr. Chairman for holding this hearing about the National Polar-Orbiting Operational Environmental Satellite System, NPOESS. This hearing continues close oversight of this vital weather satellite program, oversight that started under the Republican leadership of this committee.

Under the Republican leadership in the last Congress, this committee held three high-profile hearings about NPOESS. In looking over the testimony for today's hearing, it appears to me that close oversight has paid off. For the most part, the program is on track under the new plan announced in June of 2006.

Of course, risks remain for a satellite known as "the most complex environmental satellite system ever developed," but the government has plans in place to address most of the risks identified by GAO. Also, the government is actively examining the options to provide environmental data that we had expected from NPOESS but under the new plan we will not receive.

But simply because things appear under control right now, I don't want to imply that Congress, or the Administration for that matter, can back off from our close oversight of NPOESS. In fact, I believe just the opposite. Lack of oversight of the management of NPOESS, the contractor, and the many technical problems facing NPOESS all led to the June 2006, Nunn-McCurdy certification in the first place.

Those of us responsible for this program—Congress, NOAA, the Air Force, and NASA—cannot sit back and relax or we will risk yet another four-year delay or doubling of costs. NPOESS today is a $12.5 billion program. That is a lot of taxpayer money. We expect that investment to provide a series of weather satellites that are launched on time and provide data to inform everything from decisions about our military troop operations to forecasting the path of hurricanes.

Also, I expect that the interagency report on avoiding gaps in other environmental data be completed as soon as reasonably possible. The longer we wait to make a final decision on this, the greater risk we face of having a gap in data important for understanding global climate change and for seasonal forecasts of events like El Niño.

I look forward to hearing from our witnesses today and yield back the balance of my time.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Good afternoon. Thank you, Chairman Lampson, for holding this hearing about the National Polar-orbiting Operational Environmental Satellite System, NPOESS. This hearing continues close oversight of this vital weather satellite program, oversight that started under Republican leadership of this committee.

Under Republican leadership in the last Congress, this committee held three high-profile hearings about NPOESS. In looking over the testimony for today's hearing, it appears to me that close oversight has paid off. For the most part, the program is on track under the new plan announced in June 2006.

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I look forward to hearing from our witnesses today and yield back the balance of my time.

Chairman LAMPSON. Thank you, Mr. Inglis. I ask unanimous consent that all additional opening statements submitted by the Committee Members be included in the record. Without objection so ordered.

[The prepared statement of Mr. Udall follows:]

PREPARED STATEMENT OF REPRESENTATIVE MARK UDALL

Mr. Chairman, I'm very concerned about the status of the entire NPOESS program, not only because of the critically important climate data that may be lost if a home is not found for the de-manifested instruments, but also because the de-manifesting of those instruments is having a great impact on my district.

On the plus side, I am pleased that NASA and NOAA have worked together to find the funding needed to bring back the OMPS Limb sensor for the NPP spacecraft. OMPS Limb, which is being built by Ball Aerospace in Boulder, will provide measurements of ozone in our atmosphere.

However, it is clear that other instruments are not faring as well. I am particularly concerned about the Total Solar Irradiance Sensor (TSIS) and the Space Environment Sensor Suite (SESS).

TSIS will provide essential data on the impact that the sun has on our atmosphere and climate—and it is the number one priority instrument listed in the recent National Research Council's *Decadal Survey on Earth Science.* It was being developed by the University of Colorado's Laboratory for Atmospheric and Space Physics.

However, with the funding pulled for this instrument for NPOESS, the researchers and engineers working on this instrument may have to leave LASP to find other careers, jeopardizing our ability to have this instrument available to fly when needed.

We need one agency to take responsibility for this critical instrument and its funding. NASA and NOAA would be the logical agencies and I hope that a decision is made about a lead agency soon. TSIS has been abandoned for too long and, unless additional funding is found by the middle of July, we are going to lose critical human capital.

I am also very concerned about the status of the SESS. The information that it provides is essential for us to better understand and predict solar flares and their impact on our economy. These flares have wide reaching impacts on everything from airplane flights over the poles to telecommunications across the world. The Space Environment Center in my district has been key to enabling governments and businesses prepare for increased solar activity. Yet without SESS, we will not only curb our advances, but we may also lose the capabilities that we currently have.

I will continue to closely monitor the status of TSIS and SESS, along with the rest of NPOESS.

Chairman LAMPSON. We are very pleased to have this distinguished panel of witnesses here this afternoon. Dr. John Marburger, a science advisor to the President and Director of the Office of Science and Technology Policy, OSTP, in the Executive Office of the President. Prior to his appointment as Director of OSTP, Dr. Marburger served as Director of the Brookhaven National Laboratory in New York and as President of the State University of New York at Stony Brook. Dr. Marburger has appeared before our committee many times. Today he is here to discuss OSTP's efforts to provide continuity in our climate observing system, and I thank you for being here. Good afternoon.

Mr. David Powner is the Director of IT Management Issues for the U.S. Government Accountability Office, GAO. Mr. Powner and his team have been diligently tracking satellite procurement programs for this committee since 2001. He is here today to discuss their latest report on the current status of the NPOESS program. Your team's work has been extremely valuable to the Members of the Committee. We thank you for your excellent work and for being here to testify this afternoon.

And finally we have Brigadier General Susan Mashiko. General Mashiko is the Program Executive Officer for Environmental Satellites. She oversees the Integrated Program Office, the tri-agency organization that is in charge of the development of the new polar satellite system, NPOESS. General Mashiko has held a variety of positions in the Department of Defense, including Program Manager for the Atlas V Program, Chief of the Programs Division in the Office of Special Projects, and Executive Officer to the DOD Space Architect. She has been overseeing the NPOESS program since November of 2005, and we are pleased to have you here this afternoon as well, General.

You will each have five minutes for your spoken testimony. Your written testimony may be included in the record for the hearing.

And when all three of you have completed your testimony, we will begin with questions. Each Member will have five minutes to question the panel, and we will rotate.

Dr. Marburger, would you please begin?

STATEMENT OF DR. JOHN H. MARBURGER, III, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. MARBURGER. Thank you very much, Chairman Lampson, and Ranking Member Inglis, and Members of the Committee. I am pleased to appear today to describe the activities of OSTP and Executive Branch agencies related to the NPOESS program. My written testimony discusses the ongoing interagency assessment of the impacts of de-manifesting several Earth-observing and space environment sensors from the NPOESS spacecraft during the 2006 restructuring of the program. My written testimony also discusses some other related systems, and I appreciate it being included in the record.

The background material in your charter for today's hearing describes the history of the NPOESS program, and I will not repeat it here. From the point of view of science impacts, it is important to understand that in the restructuring process the agencies gave highest priority to preserving continuity and operational terrestrial weather forecasting capabilities, which was the original focus of the program. And as you know the restructuring decision which was announced on June 5, 2006, reduced the number of operating NPOESS satellites and orbits and also removed several Earth-observing and space weather-related sensors from the baseline program budget.

When my office learned of these decisions, we convened an interagency meeting later that June, including representatives from NASA, NOAA, and the NPOESS Integrated Program Office. We wanted first to gain a better understanding of the projected capabilities of the revised program; second, to explore the implications of these changes for climate and ocean research activities; and third, to obtain agency views and information on ways to retain the capabilities of sensors removed from the baseline. Based on discussions in this meeting we asked NASA and NOAA to provide my office, OSTP, with a joint technical assessment of the expected science implications of the NPOESS restructuring decision and options for addressing those impacts in terms of climate research. NASA/NOAA responded with a white paper in January of this year.[6]

This initial response included a good analysis of the potential climate science impacts of the restructuring decision. It also addressed the projected impacts of eliminating each sensor and prioritized the de-manifested sensors in terms of the importance of their measurements.

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[6] *Impacts of NPOESS Nunn-McCurdy Certification on Joint NASA–NOAA Climate Goals.* Earth Science Division, Science Mission Directorate, Headquarters, National Aeronautics and Space Administration, and Climate Observations and Analysis Program, Climate Program Office, National Oceanic and Atmospheric Administration. January 8, 2007.

The options it presented for retaining the capabilities of the eliminated sensors focused mostly on re-manifesting them back onto NPOESS.

Because that white paper did not include the full range of options for retaining climate and ocean research capabilities and did not make cost estimates that are essential for policy-making, OSTP asked the agencies for more information on these issues, and NASA and NOAA are in the process of developing that information.

Interagency discussions and follow-up questions and analyses will continue throughout the summer and fall and feed into the fiscal year 2009 budget process. One important decision has already been made. The sensor known as OMPS–Limb[7] has been restored to fly on NASA's NPOESS Preparatory Project satellite, the NPP, which is scheduled to launch in 2009. NASA and NOAA will split the cost to re-manifest the OMPS–Limb instrument.

I want to thank this committee for its interest in this project and its support of the program and related sensor studies. We face more challenges in addressing these topics, but we are making progress. We are working closely with interested agencies in devising the way forward.

And I would be pleased to respond to questions.

[The prepared statement of Dr. Marburger follows:]

PREPARED STATEMENT OF JOHN H. MARBURGER, III

Chairman Lampson, Ranking Member Inglis, and Members of the Subcommittee, I am pleased to appear before you today to describe OSTP and interagency activities related to the National Polar-orbiting Operational Environmental Satellite System (NPOESS) weather satellite program. As you requested, I will discuss the ongoing interagency assessment of the impacts of removing or "de-manifesting" several Earth-observing and space environment sensors from the NPOESS spacecraft during the 2006 restructuring of the program. I will also describe certain other important climate-related activities of potential interest to the Committee.

First let me briefly outline the NPOESS program and its history. The NPOESS effort was established through Presidential Decision Directive in 1994, with the goal of integrating the polar weather capabilities developed by the Department of Defense (DOD) and the Department of Commerce (DOC) into one next-generation program that would support both civil and military weather requirements. The role of the National Aeronautics and Space Administration (NASA) was to improve the remote sensing capabilities of the operational system through the insertion of new technologies. The idea was to have one next-generation program that would support both civil and military weather requirements and to align overlapping and complementary capabilities to increase efficiency and data synergy. As planning evolved, a number of other Earth-observing and space environment sensors and capabilities were incorporated into the basic program, making NPOESS (as envisioned at that time) a key component not only for operational weather forecasting, but also for research on climate, oceans, and space weather.

Oversight of the NPOESS program is provided jointly by the three agencies through an Executive Committee, and funding is divided equally between DOD and DOC. Within this tri-agency framework, DOD is responsible for major program acquisitions (conducted through the Air Force), DOC's National Oceanic and Atmospheric Administration (NOAA) is responsible for satellite operations, and NASA is responsible for developing new technologies. Development and other activities within the program are managed by an integrated program office. These arrangements for NPOESS are unique within the Federal Government, and many consider it the most complex environmental satellite system ever developed.

Previous communications to Congress during hearings and in Executive Branch correspondence have reported numerous technical, developmental, and management challenges in the NPOESS program since its inception, resulting in various cost increases and scheduling delays. In late 2005, the NPOESS integrated program office determined that projected cost over-runs for NPOESS would exceed the 25 percent threshold triggering a breach of the Nunn-McCurdy statute, thus requiring the Secretary of Defense to certify that the program meets the following criteria: it is essential to the national security, no alternatives provide equal or greater military capability at less cost, new estimates of the program acquisition unit cost are reasonable, and the management structure is adequate to manage and control program costs. Accordingly, DOD worked with DOC and NASA through the first half of 2006 to restructure the NPOESS effort in order to address the significant cost over-run and reduce program risk. In this certification process, the agencies gave highest priority to preserving continuity in operational terrestrial weather forecasting capabilities—the original focus of the program. The ultimate decision regarding the restructuring of NPOESS was announced on June 5, 2006.

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[7] OMPS: Ozone Mapping and Profiler Suite.

The current restructured NPOESS program includes four NPOESS satellites operating in two orbits, augmented by data from a European weather system using several sensors provided by the United States in a third orbit. (In contrast, the program before restructuring had planned on flying six NPOESS satellites in three orbits.) To decrease costs and help maintain continuity in operational weather capabilities, the three agencies also decided to remove several Earth-observing and space weather-related sensors from the baseline NPOESS program budget—effectively removing these sensors from NPOESS—and to de-scope certain other instruments in terms of performance. It is important to note that NPOESS, as restructured, still satisfies many climate data requirements. In addition, the recertified program retains funding within the NPOESS baseline for the reintegration of the de-manifested sensors should a way be found to provide them from outside the program. Nevertheless, the potential impacts to the climate science program continue to raise concerns.

When my office (OSTP) learned of these decisions, we convened an interagency meeting in late June 2006, including representatives from NASA, NOAA and the NPOESS integrated program office, to (1) gain a better understanding of the projected capabilities of the revised program, (2) explore the implications of these changes for climate and ocean research activities, and (3) obtain agency views on ways to retain the capabilities of sensors removed from the baseline NPOESS configuration. Based on the discussions in this meeting and our sense that more work was needed on these topics, we asked NASA and NOAA to provide OSTP with a joint technical assessment of the expected science implications of the NPOESS restructuring decision, and options for addressing those impacts in terms of climate research (implications for space weather research and activities will be addressed separately). In response to our request, a joint NASA/NOAA assessment was provided to OSTP in early January 2007, in the form of a "white paper."

The initial NASA/NOAA response to OSTP includes an analysis of the potential climate science impacts of the 2006 NPOESS restructuring decision. It also addresses the projected impacts of eliminating each sensor and provides prioritized rankings of the de-manifested sensors in terms of the importance of their measurements. In addition, the white paper presents options for retaining the capabilities of the eliminated sensors that focus largely on re-manifesting them back onto NPOESS.

The NASA/NOAA white paper is useful for understanding the dimensions of the problems created by restructuring, and is a helpful and important contribution to the process of resolving them. At the same time, it does not include the full range of options for retaining the climate and ocean research capabilities, and does not include cost estimates that are essential for policy-making. Consequently, OSTP asked the agencies for further analysis of a broader range of options, including potential solutions such as free-flyers, adding instruments to other U.S. Government spacecraft, or international cooperative opportunities. We also requested that NASA and NOAA provide cost estimates for the full range of options being explored. NASA and NOAA are in the process of developing information for OSTP and the Office of Management and Budget regarding various options and preliminary cost estimates for those options.

Interagency discussions and follow-up questions and analyses regarding these and other potential mitigation strategies will continue throughout the summer and fall. Our goal is to complete this phase of the analysis in time to inform the FY 2009 budget process, where this information could be considered along with other elements of department and agency requests. One decision has already been made—the Ozone Mapping and Profiler Suite (OMPS) Limb has been restored to fly on the NPOESS Preparatory Project (NPP) satellite, which is scheduled to launch in 2009. NASA and NOAA will split the cost to re-manifest the OMPS–Limb instrument.

Regarding instruments other than OMPS–Limb, there have been no decisions yet on options, program schedules, or identification of funds. Those issues will need to be addressed as the process unfolds in coming months. My priorities during this review are to promote continuity of key climate data needs while ensuring that current planned missions are not negatively impacted by payload modifications. While much remains to be completed, I must emphasize that NASA, NOAA and members of my staff are investing much time and effort on this difficult problem. Other portions of the scientific community are providing useful input as well. For example, we are looking forward to the results of an NRC workshop later this month regarding these and related Earth-observation issues. The necessary work is getting done, and OSTP will continue to monitor the process closely as it moves forward.

In addition to the NPOESS climate-related sensors that are the focus of the ongoing assessment, a suite of space weather sensors was also de-manifested from the baseline NPOESS effort during the 2006 restructuring of the program, as noted earlier. These sensors were an important element of the Nation's planned capabilities for observing and predicting space weather phenomena such as solar flares, sunspots, auroras and the solar wind. The loss of such measurements could have a serious impact on a wide range of U.S. operations and research. Accordingly, and as with the de-manifested climate sensors, we have requested that agencies with space weather interests, including DOD, DOC, and NASA, provide a joint assessment of the impacts of the NPOESS restructuring decision on national space weather-related capabilities and goals, followed by an assessment of potential options for addressing such impacts. This effort is in its early stages and likely will require several months to complete. Our goal in this effort is to obtain the necessary information in time to inform the FY 2010 budget process—a suitable schedule for this analysis according to the agencies involved.

I would like to mention some other climate-related issues today that are not directly linked to NPOESS but are part of the broader context for OSTP's ongoing work on Earth observations. The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) shows that great progress has been made in characterizing and understanding Earth's climate system and how that system is changing, and U.S. Government-funded Earth observations have been critical in achieving this progress. Earth observations are important for characterizing the impacts of climate change to natural and human systems, and for many other applications such as improved weather forecasts, predicting and responding to natural disasters, water resource management, characterizing air quality and assessing ecosystem health. While current challenges to maintaining and improving U.S. Earth-observing systems exist, as noted in the recently released National Research Council (NRC) *Decadal Survey on Earth Science,* I want to emphasize that this Administration is committed to supporting these capabilities.

The NRC report points out that no single mechanism currently exists for coordinating all national Earth-observing needs across agencies. Although the Climate Change Science Program has an Observations Working Group to facilitate interagency understanding and information exchanges, it has not yet developed a national strategy for climate observations—nor has any other group. Climate observation plans have been part of individual agency program plans and budgets, or have been assembled through mission-specific collaborative processes like the one that produced NPOESS. This situation exists for most other observation types as well, not just those for climate. For example, there is an Interagency Working Group on Ocean Observations that is looking at a range of ocean-related observations, including but not limited to, those focusing on climate. Similarly, there is a NASA–NOAA Joint Working Group on Research-Operations Transition intended to address issues associated with the transition of observations initiated as research into operational ones.

Several organizations including the NRC have noted the need for a plan to achieve and sustain global Earth observations, and this issue has been taken up by the National Science and Technology Council Subcommittee on Earth Observations (known as the U.S. Group on Earth Observations, or USGEO). USGEO, which is co-chaired by OSTP, NASA, and NOAA, recently reorganized to focus on a national strategy for Earth observations that would address topics such as organizational roles and responsibilities, data collection and sharing protocols, and sector-specific priorities for investment. This process is ongoing, and I anticipate that at least a year will be required to produce a strategic plan for this complex issue.

OSTP is also engaged in an emerging national coordination requirement for medium-resolution land imaging data. I have directed an interagency working group to address the long-term continuity of Landsat-type data through an effort known as the Future of Land Imaging (FLI) Plan. As you know, the Landsat Data Continuity Mission (LDCM) is currently in procurement in NASA and is scheduled for launch in 2011. The Landsat interagency working group is developing the FLI plan for extending these important systems beyond LDCM and into the future. The group's report is currently in clearance and will be published within the next two months.

Thank you for your interest in and support for these issues, including not only the NPOESS-related sensor studies but also the other Earth-observing topics that I have mentioned. There certainly are further challenges ahead in addressing these topics, but we are making progress and are working closely with interested agencies in devising the way forward. I would be pleased to respond to questions.

BIOGRAPHY FOR JOHN H. MARBURGER, III

John H. Marburger, III, Science Adviser to the President and Director of the Office of Science and Technology Policy, was born on Staten Island, N.Y., grew up in Maryland near Washington D.C. and attended Princeton University (B.A., Physics 1962) and Stanford University (Ph.D., Applied Physics 1967). Before his appointment in the Executive Office of the President, he served as Director of Brookhaven National Laboratory from 1998, and as the third President of the State University of New York at Stony Brook (1980–1994). He came to Long Island in 1980 from the University of Southern California where he had been a Professor of Physics and Electrical Engineering, serving as Physics Department Chairman and Dean of the College of Letters, Arts and Sciences in the 1970's. In the fall of 1994 he returned to the faculty at Stony Brook, teaching and doing research in optical science as a University Professor. Three years later he became President of Brookhaven Science Associates, a partnership between the university and Battelle Memorial Institute that competed for and won the contract to operate Brookhaven National Laboratory.

While at the University of Southern California, Marburger contributed to the rapidly growing field of nonlinear optics, a subject created by the invention of the laser in 1960. He developed theory for various laser phenomena and was a co-founder of the University of Southern California's Center for Laser Studies. His teaching activities included "Frontiers of Electronics," a series of educational programs on CBS television.

Marburger's presidency at Stony Brook coincided with the opening and growth of University Hospital and the development of the biological sciences as a major strength of the university. During the 1980's federally sponsored scientific research at Stony Brook grew to exceed that of any other public university in the northeastern United States.

During his presidency, Marburger served on numerous boards and committees, including chairmanship of the Governor's Commission on the Shoreham Nuclear Power facility, and chairmanship of the 80 campus "Universities Research Association" which operates Fermi National Accelerator Laboratory near Chicago. He served as a trustee of Princeton University and many other organizations. He also chaired the highly successful 1991/92 Long Island United Way campaign.

As a public spirited scientist-administrator, Marburger has served local, State and Federal governments in a variety of capacities. He is credited with bringing an open, reasoned approach to contentious issues where science intersects with the needs and concerns of society. His strong leadership of Brookhaven National Laboratory following a series of environmental and management crises is widely acknowledged to have won back the confidence and support of the community while preserving the Laboratory's record of outstanding science.

Chairman LAMPSON. Thank you, Dr. Marburger.

Mr. Powner.

STATEMENT OF MR. DAVID A. POWNER, DIRECTOR, INFORMATION TECHNOLOGY MANAGEMENT ISSUES, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. POWNER. Chairman Lampson, Ranking Member Inglis, and Members of the Subcommittee, we appreciate the opportunity to testify on NPOESS, a planned satellite system whose life cycle costs will now exceed $12 billion.

NPOESS is critical to our nation's ability to monitor changes in weather and the environment. Over the past several years NPOESS has experienced significant cost overruns and delays due to sensor development problems, poor contractor performance and program management, and inadequate executive level involvement that led to a June, 2006, decision to restructure the program.

This decision decreased the complexity of the program by reducing the number of sensors, increased the estimated cost by $4 billion, and delayed the launches of satellites by three to five years. Since then the NPOESS program has made progress and is currently being managed with much more rigor than we have previously seen as part of our numerous reviews for this committee.

However, we remain concerned about its remaining risks; the interagency management of this tri-agency program, the premature rotation of the program's key executive, continued staffing shortages, and whether this program can be executed within the $12.5 billion life cycle cost estimate.

Before expanding on each of these concerns, General Mashiko and her team deserve credit for increasing program oversight, instituting more frequent and rigorous program reviews, and holding NPOESS's contractors more accountable. In addition, this committee's oversight role has been instrumental in driving these management improvements. Despite these efforts, the NPOESS program is still fraught with risks. Recent program assessments to NPOESS's Executive Committee rate the cost, schedule, technical and funding status each as yellow. Our report being released today[8] highlights the major technical risks associated with two critical sensors known as VIIRS and CrIS. Specifically, VIIRS has experienced problems during testing with image quality and reliability, and CrIS failed during vibration testing. Both sensors remain high risk.

We also remain concerned about the interagency coordination and commitment required to effectively manage this tri-agency program. Following last summer's restructuring, the Secretaries of Defense and Commerce and the Administrator of NASA were required to sign a revised memorandum of agreement by August, 2006, and revise and approve key acquisition documents a month later. To date this has not occurred, and this executive level foot-dragging is unacceptable.

This is more than a paper exercise since finalizing these documents is critical to insuring interagency agreements and will allow the programs to move forward in completing a new baseline and contract by next month.

We also remain concerned about having the right people on board to effectively oversee and manage this program. DOD's plans for reassigning the Program Executive Officer (PEO) next month increases the program's risk. Establishing the PEO structure and having a seasoned executive in this role has streamlined executive decision-making and has resulted in more aggressive risk management throughout the program. The PEO has only been in this position for 19 months. Given that the program is currently still being restructured and that significant challenges remain, this move adds unnecessary risks to an already risky program.

In addition, the NPOESS program still lacks key staff needed to effectively manage this program. These staff include systems engineers and budget and cost analysts. As a result the program lacks the staff it needs to oversee the technical aspects of the program and assess contractor costs and progress reports.

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[8] *Polar-Orbiting Operational Environmental Satellites: Restructuring Is Underway But Technical Challenges and Risks Remain.* Government Accountability Office Report GAO–07–498; April 27, 2007.

Finally, we remain skeptical of the program's ability to execute within the $12.5 billion. Specifically, the costs will likely increase due to the technical problems associated with key sensors. In addition, the contractors' preliminary estimate of the restructured program is higher than current estimates. The extent of these increases should be known next month when contractor negotiations are expected to conclude.

In summary, Mr. Chairman, despite some progress, NPOESS is far from being out of the woods. Moving forward, it is essential that the program aggressively manage its remaining developmental risks—especially those associated with high-risk sensors—approve key documents to assure tri-agency agreement and commitment is in place, staff key positions to ensure the right folks are on-board—especially in the engineering and cost areas—and strongly consider reevaluating the reassignment of the PEO until next summer when key sensors are to be delivered for NPOESS's demonstration satellite. Failing to address any of these concerns will lead to additional cost increases and scheduled delays.

This concludes my statement. Thank you for your leadership and oversight of this critical acquisition.

[The prepared statement of Mr. Powner follows:]

PREPARED STATEMENT OF DAVID A. POWNER

Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to participate in today's hearing to discuss our work on the $12.5 billion dollar National Polar-orbiting Operational Environmental Satellite System (NPOESS) program. NPOESS is expected to be a state-of-the-art, environment-monitoring satellite system that will replace two existing polar-orbiting environmental satellite systems. Polar-orbiting satellites provide data and imagery that are used by weather forecasters, climatologists, and the military to map and monitor changes in weather, climate, the oceans, and the environment. The NPOESS program is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting (including severe weather events such as hurricanes) and global climate monitoring through the year 2026.

Three agencies share responsibility for the NPOESS program: the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD)/United States Air Force, and the National Aeronautics and Space Administration (NASA). To manage the NPOESS program, these agencies established a tri-agency integrated program office. In recent years, the program has experienced escalating costs, schedule delays, and technical difficulties, which led to a June 2006 decision to restructure it. This decision decreased the complexity of the program by reducing the number of satellites and sensors, increased the estimated cost of the program to $12.5 billion, and delayed the launches of the first two satellites by three and five years, respectively.

As requested, this statement summarizes a report being released today that (1) assesses the NPOESS program office's progress in restructuring the acquisition, (2) evaluates the program office's progress in establishing an effective management structure, and (3) identifies the status and key risks facing the program's major segments.[1] The report includes recommendations to NOAA, NASA, and DOD to facilitate the restructuring of the program and to reduce program risks. In preparing this testimony, we relied on our work supporting the accompanying report. That report contains a detailed overview of our scope and methodology. All the work on which this testimony is based was performed in accordance with generally accepted government auditing standards.

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[1] GAO, *Polar-Orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain,* GAO–07–498 (Washington, D.C.: Apr. 27, 2007).

Results in Brief

The NPOESS program office has made progress in restructuring the acquisition by establishing and implementing interim program plans guiding contractors' work activities in 2006 and 2007; however, important tasks remain to be done. Although the program office developed key acquisition documents (including a memorandum of agreement on the roles and responsibilities of the three agencies, a revised acquisition strategy, and a system engineering plan) the responsible executives in the three agencies have not yet approved these documents—even though they were due by September 1, 2006. Delays in finalizing these documents could hinder plans to complete contract negotiations by July 2007 and could keep the program from moving forward in fiscal year 2008 with a new program baseline.

The program office has also made progress in establishing an effective management structure by adopting a new organizational framework with increased oversight from program executives and by instituting more frequent and rigorous program management reviews; however, planned changes in executive management will likely increase program risk. Additionally, the program lacks a process and plan for identifying and filling staffing shortages, which has led to delays in key activities such as cost estimating and contract revisions. As of June 2007, key positions remain to be filled.

Development and testing of major program segments—including key sensors and the ground systems—are under way, but significant risks remain. For example, work continues on key sensors, but two sensors—the visible/infrared imager radiometer suite and the crosstrack infrared sounder—have continued to experience significant difficulties. Additionally, while significant progress has been made in reducing delays in the NPOESS data processing system, much work remains in refining the algorithms needed to translate sensor observations into usable weather products. Continued sensor problems could cause further cost increases or schedule delays. Given the tight time frames for completing key sensors, integrating them with the demonstration spacecraft (called the NPOESS Preparatory Project or NPP), and developing, testing, and deploying the ground-based data processing systems, it will be important for the Integrated Program Office, the Program Executive Office, and the Executive Committee to continue to provide close oversight of milestones and risks.

In our report, we made recommendations to the Secretaries of Commerce and Defense and to the Administrator of NASA to ensure that the appropriate executives finalize key acquisition documents in order to allow the restructuring of the program to proceed. We made recommendations to the Secretary of Defense to direct the Air Force to delay reassigning the recently appointed Program Executive Officer until key program risks are resolved. We also made recommendations to the Secretary of Commerce to ensure that NPOESS program authorities develop and implement a written process for identifying and addressing human capital needs and that they establish a plan to immediately fill needed positions. In written comments, all three agencies agreed that it was important to finalize key acquisition documents in a timely manner, and DOD proposed extending the due dates for the documents to July 2, 2007. In addition, the Department of Commerce concurred with our recommendation to identify and address human capital needs and immediately fill open positions in the NPOESS program office. Commerce noted that NOAA was taking actions in both areas.

However, DOD did not concur with our recommendation to delay reassigning the Program Executive Officer, noting that the Program Director responsible for the acquisition program would remain in place for four years. While it is important that the System Program Director remain in place to ensure continuity in executing the acquisition, this position does not ensure continuity in the important oversight and coordination functions provided by the current Program Executive Officer. We remain concerned that reassigning the Program Executive at a time when NPOESS is still facing critical cost, schedule, and technical challenges will place the program at further risk.

Background

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series—managed by NOAA—and the Defense Meteorological Satellite Program (DMSP)—managed by the Air Force. These satellites obtain environmental data that are processed to provide graphical weather images and specialized weather products. These satellite data are also the predominant input to numerical weather prediction models, which are a primary tool for forecasting weather three or more days in advance—including forecasting the path and intensity of hurricanes. The weather products and models are used to predict the potential impact of severe weather so that communities and emergency managers can help prevent and mitigate their effects. Polar satellites also provide data used to monitor environmental phenomena, such as ozone depletion and drought conditions, as well as data sets that are used by researchers for a variety of studies such as climate monitoring.

NPOESS Overview

With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive required NOAA and DOD to converge the two satellite programs into a single satellite program capable of satisfying both civilian and military requirements.[2] The converged program, NPOESS, is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring through the year 2026. To manage this program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office, located within NOAA.

Within the program office, each agency has the lead on certain activities: NOAA has overall program management responsibility for the converged system and for satellite operations; DOD has the lead on the acquisition; and NASA has primary responsibility for facilitating the development and incorporation of new technologies into the converged system. NOAA and DOD share the costs of funding NPOESS, while NASA funds specific technology projects and studies. The NPOESS program office is overseen by an Executive Committee, which is made up of the Administrators of NOAA and NASA and the Under Secretary of the Air Force.

NPOESS is a major system acquisition that was originally estimated to cost about $6.5 billion over the 24-year life of the program from its inception in 1995 through 2018. The program is to provide satellite development, satellite launch and operation, and ground-based satellite data processing. These deliverables are grouped into four main categories: (1) the space segment, which includes the satellites and sensors; (2) the integrated data processing segment, which is the system for transforming raw data into environmental data records (EDR) and is to be located at four data processing centers; (3) the command, control, and communications segment, which includes the equipment and services needed to support satellite operations; and (4) the launch segment, which includes launch vehicle services.

When the NPOESS engineering, manufacturing, and development contract was awarded in August 2002, the cost estimate was adjusted to $7 billion. Acquisition plans called for the procurement and launch of six satellites over the life of the program, as well as the integration of 13 instruments—consisting of 10 environmental sensors and three subsystems. Together, the sensors were to receive and transmit data on atmospheric, cloud cover, environmental, climatic, oceanographic, and solar-geophysical observations. The subsystems were to support non-environmental search and rescue efforts, sensor survivability, and environmental data collection activities. The program office considered four of the sensors to be critical because they provide data for key weather products; these sensors are in bold in Table 1, which describes each of the expected NPOESS instruments.

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[2] Presidential Decision Directive NSTC–2 (May 5, 1994).

Table 1: Expected NPOESS Instruments as of August 31, 2004 (critical sensors are in bold)

Instrument	Description
Advanced technology microwave sounder (ATMS)	Measures microwave energy released and scattered by the atmosphere and is to be used with infrared sounding data from NPOESS's cross-track infrared sounder to produce daily global atmospheric temperature, humidity, and pressure profiles.
Aerosol polarimetry sensor	Retrieves specific measurements of clouds and aerosols (liquid droplets or solid particles suspended in the atmosphere, such as sea spray, smog, and smoke).
Conical-scanned microwave imager/sounder (CMIS)	Collects microwave images and data needed to measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, and soil moisture, as well as temperature and humidity at different atmospheric levels.
Cross-track infrared sounder (CrIS)	Collects measurements of the Earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.
Data collection system	Collects environmental data from platforms around the world and delivers them to users worldwide.
Earth radiation budget sensor	Measures solar short-wave radiation and long-wave radiation released by the Earth back into space on a worldwide scale to enhance long-term climate studies.
Ozone mapper/profiler suite (OMPS)	Collects data needed to measure the amount and distribution of ozone in the Earth's atmosphere.
Radar altimeter	Measures variances in sea surface height/topography and ocean surface roughness, which are used to determine sea surface height, significant wave height, and ocean surface wind speed and to provide critical inputs to ocean forecasting and climate prediction models.
Search and rescue satellite aided tracking system	Detects and locates aviators, mariners, and land-based users in distress.
Space environmental sensor suite	Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.
Survivability sensor	Monitors for attacks on the satellite and notifies other instruments in case of an attack.
Total solar irradiance sensor	Monitors and captures total and spectral solar irradiance data.
Visible/infrared imager radiometer suite (VIIRS)	Collects images and radiometric data used to provide information on the Earth's clouds, atmosphere, ocean, and land surfaces.

Source: GAO, based on NPOESS program office data.

In addition, a demonstration satellite (called the NPOESS Preparatory Project or NPP) was planned to be launched several years before the first NPOESS satellite in order to reduce the risk associated with launching new sensor technologies and to ensure continuity of climate data with NASA's Earth Observing System satellites. NPP is to host three of the four critical NPOESS sensors (VIIRS, CrIS, and ATMS), as well as one other noncritical sensor (OMPS). NPP is to provide the program office and the processing centers an early opportunity to work with the sensors, ground control, and data processing systems.

When the NPOESS development contract was awarded, the schedule for launching the satellites was driven by a requirement that the satellites be available to back up the final POES and DMSP satellites should anything go wrong during the planned launches of these satellites. Early program milestones included (1) launching NPP by May 2006, (2) having the first NPOESS satellite available to back up the final POES satellite launch in March 2008, and (3) having the second NPOESS satellite available to back up the final DMSP satellite launch in October 2009. If the NPOESS satellites were not needed to back up the final predecessor satellites, their anticipated launch dates would have been April 2009 and June 2011, respectively.

NPOESS Experienced Cost Increases, Schedule Delays, and Technical Problems Over Several Years

Over the last few years, NPOESS has experienced continued cost increases and schedule delays, requiring difficult decisions to be made about the program's direction and capabilities. In 2003, we reported that changes in the NPOESS funding stream led the program to develop a new program cost and schedule baseline.[3] After this new baseline was completed in 2004, we reported that the program office increased the NPOESS cost estimate from about $7 billion to $8.1 billion; delayed key milestones, including the planned launch of the first NPOESS satellite—which was delayed by seven months; and extended the life of the program from 2018 to 2020.[4] At that time, we also noted that other factors could further affect the revised cost and schedule estimates. Specifically, the contractor was not meeting expected cost and schedule targets on the new baseline because of technical issues in the development of key sensors, including the critical VIIRS sensor. Based on its performance through May 2004, we estimated that the contractor would most likely overrun its contract at completion in September 2011 by $500 million—thereby increasing the projected life cycle cost to $8.6 billion. The program office's baseline cost estimate was subsequently adjusted to $8.4 billion.

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[3] GAO, *Polar-orbiting Environmental Satellites Project Risks Could Affect Weather Data Needed by Civilian and Military Users,* GAO–03–987T (Washington, D.C.: July 15, 2003).

[4] GAO, *Polar-orbiting Environmental Satellites Information on Program Cost and Schedule Changes,* GAO–04–1054 (Washington, D.C.: Sept. 30, 2004).

In mid-November 2005, we reported that NPOESS continued to experience problems in the development of a key sensor, resulting in schedule delays and anticipated cost increases.[5] At that time, we projected that the program's cost estimate had grown to about $10 billion based on contractor cost and schedule data. We reported that the program's issues were due, in part, to problems at multiple levels of management—including subcontractor, contractor, program office, and executive leadership. Recognizing that the budget for the program was no longer executable, the NPOESS Executive Committee planned to make a decision in December 2005 on the future direction of the program—what would be delivered, at what cost, and by when. This involved deciding among options involving increased costs, delayed schedules, and reduced functionality. We noted that continued oversight, strong leadership, and timely decision-making were more critical than ever, and we urged the committee to make a decision quickly so that the program could proceed.

However, we subsequently reported that, in late November 2005, NPOESS cost growth exceeded a legislatively mandated threshold that requires DOD to certify the program to Congress.[6] This placed any decision about the future direction of the program on hold until the certification took place in June 2006. In the meantime, the program office implemented an interim program plan for fiscal year 2006 to continue work on key sensors and other program elements using fiscal year 2006 funding.

Nunn-McCurdy Process Led to a Decision to Restructure the NPOESS Program

The Nunn-McCurdy law requires DOD to take specific actions when a major defense acquisition program exceeds certain cost increase thresholds.[7] The law requires the Secretary of Defense to notify Congress when a major defense acquisition is expected to overrun its project baseline by 15 percent or more and to certify the program to Congress when it is expected to overrun its baseline by 25 percent or more.[8] In late November 2005, NPOESS exceeded the 25 percent threshold, and DOD was required to certify the program. Certifying a program entailed providing a determination that (1) the program is essential to national security, (2) there are no alternatives to the program that will provide equal or greater military capability at less cost, (3) the new estimates of the program's cost are reasonable, and (4) the management structure for the program is adequate to manage and control costs. DOD established tri-agency teams—made up of DOD, NOAA, and NASA experts—to work on each of the four elements of the certification process.

In June 2006, DOD (with the agreement of both of its partner agencies) certified a restructured NPOESS program, estimated to cost $12.5 billion through 2026.[9] This decision approved a cost increase of $4 billion over the prior approved baseline cost and delayed the launch of NPP and the first two satellites by roughly three to five years. The new program also entailed establishing a stronger program management structure, reducing the number of satellites to be produced and launched from six to four, and reducing the number of instruments on the satellites from 13 to nine—consisting of seven environmental sensors and two subsystems. It also entailed using NPOESS satellites in the early morning and afternoon orbits and relying on European satellites for midmorning orbit data.[10] Table 2 summarizes the major program changes made under the Nunn-McCurdy certification decision.

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[5] GAO, *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions,* GAO–06–249T (Washington, D.C.: Nov. 16, 2005).

[6] GA0, *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold,* GAO–06–573T (Washington, D.C.: Mar. 30, 2006).

[7] 10 U.S.C. §2433 is commonly referred to as Nunn-McCurdy.

[8] 10 U.S.C. §2433 (e)(2) has recently been amended by Pub. L. No. 109–163, §802 (Jan. 6, 2006) and Pub. L. No. 109–364, §213 (a) (Oct. 17, 2006).

[9] DOD estimated that the acquisition portion of the certified program would cost $11.5 billion. The acquisition portion includes satellite development, production, and launch, but not operations and support costs after launch. When combined with an estimated $1 billion for operations and support after launch, this brings the program life cycle cost to $12.5 billion.

[10] The European Organization for the Exploitation of Meteorological Satellite's MetOp program is a series of three polar-orbiting satellites dedicated to operational meteorology. MetOp satellites are planned to be launched sequentially over 14 years.

Table 2: Summary of Changes to the NPOESS Program

Key area	Program before the Nunn-McCurdy decision	Program after the Nunn-McCurdy decision
Life cycle range	1995–2020	1995–2026
Estimated life cycle cost	$8.4 billion	$12.5 billion
Launch schedule	NPP by October 2006 First NPOESS by November 2009 Second NPOESS by June 2011	NPP by January 2010 First NPOESS by January 2013 Second NPOESS by January 2016
Management structure	System Program Director reports to a tri-agency steering committee and the tri-agency Executive Committee. Independent program reviews noted insufficient system engineering and cost analysis staff.	System Program Director is responsible for day-to-day program management and reports to the Program Executive Officer. Program Executive Officer oversees program and reports to the tri-agency Executive Committee.
Number of satellites	6 (in addition to NPP)	4 (in addition to NPP)
Number of orbits	3 (early morning, midmorning, and afternoon)	2 (early morning and afternoon; will rely on European satellites for midmorning orbit data)
Number and complement of instruments	13 instruments (10 sensors and 3 subsystems)	9 instruments (7 sensors and 2 subsystems); 4 of the sensors are to provide fewer capabilities
Number of EDRs	55	39 (6 are to be degraded products)

Source: GAO analysis of NPOESS Integrated Program Office data.

The Nunn-McCurdy certification decision established new milestones for the delivery of key program elements, including launching NPP by January 2010,[11] launching the first NPOESS satellite (called C1) by January 2013, and launching the second NPOESS satellite (called C2) by January 2016. These revised milestones deviated from prior plans to have the first NPOESS satellite available to back up the final POES satellite should anything go wrong during that launch.

Delaying the launch of the first NPOESS satellite means that if the final POES satellite fails on launch, satellite data users would need to rely on the existing constellation of environmental satellites until NPP data become available—almost two years later. Although NPP was not intended to be an operational asset, NASA agreed to move NPP to a different orbit so that its data would be available in the event of a premature failure of the final POES satellite. However, NPP will not provide all of the operational capability planned for the NPOESS spacecraft. If the health of the existing constellation of satellites diminishes—or if NPP data are not available, timely, and reliable—then there could be a gap in environmental satellite data. Table 3 summarizes changes in key program milestones over time.

Table 3: Key Program Milestones

Milestones	As of the August 2002 contract award	As of the February 2004 rebaselined program	As of the June 2006 certification decision	Change from 2004 rebaselined program
Final POES launch[a]	March 2008	March 2008	February 2009	Not applicable
NPP launch	May 2006	October 2006	January 2010[b]	44-month delay
First NPOESS satellite planned for launch (C1)	April 2009	November 2009	January 2013	38-month delay
Final DMSP launch[a]	October 2009	May 2010	April 2012	Not applicable
Second NPOESS satellite planned for launch (C2)	June 2011	June 2011	January 2016	55-month delay

Source: GAO analysis, based on NPOESS Integrated Program Office data.

[a] POES and DMSP are not part of the NPOESS program. Their launch dates are provided to indicate the increased risk of satellite data gaps between when these systems launch and when the NPOESS satellites launch.

[b] Although the certification decision specified that NPP is to launch by January 2010, NASA plans to launch it by September 2009 to reduce the possibility of a gap in climate data continuity.

In order to reduce program complexity, the Nunn-McCurdy certification decision decreased the number of NPOESS sensors from 13 to nine and reduced the functionality of four sensors. Specifically, of the 13 original sensors, five sensors remain unchanged, three were replaced with less capable sensors, one was modified to provide less functionality, and four were canceled. Table 4 shows the changes to NPOESS sensors, including the four identified in bold as critical sensors.

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[11] According to program officials, although the Nunn-McCurdy certification decision specifies that NPP is to launch by January 2010, NASA plans to launch it by September 2009 to reduce the possibility of a climate data continuity gap.

Table 4: Changes to NPOESS Instruments (critical sensors are in bold)

Instrument	Status of instrument after the Nunn-McCurdy decision	Change description
ATMS	Unchanged	Sensor is to be included on NPP and on the first and third NPOESS satellites.
Aerosol polarimetry sensor	Cancelled	Sensor was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it.[a]
CMIS	Replaced	CMIS sensor was cancelled, and the program office is to procure a less complex *Microwave imager/sounder* for inclusion on the second, third, and fourth NPOESS satellites.
CrIS	Unchanged	Sensor is to be included on NPP and on the first and third NPOESS satellites.
Data collection system	Unchanged	Subsystem is to be included on all four NPOESS satellites.
Earth radiation budget sensor	Replaced	Sensor was cancelled, and is to be replaced on the first NPOESS satellite (and no others) by an existing sensor with fewer capabilities called the *Clouds and the Earth's Radiant Energy System*.
OMPS	Modified	One part of the sensor, called OMPS (nadir), is to be included on NPP and on the first and third NPOESS satellites; the remaining part, called OMPS (limb), was cancelled on the NPOESS satellites, but will be included on NPP.[a]
Radar altimeter	Cancelled	Sensor was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it.
Search and rescue satellite aided tracking system	Unchanged	Subsystem is to be included on all four NPOESS satellites.
Space environmental sensor suite	Replaced	Sensor is to be replaced by a less capable, less expensive, legacy sensor called the *Space Environment Monitor* on the first and third NPOESS satellites.
Survivability sensor	Cancelled	Subsystem contract was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it.
Total solar irradiance sensor	Cancelled	Sensor contract was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it.
VIIRS	Unchanged	Sensor is to be included on NPP and on all four NPOESS satellites.

Source: GAO analysis of NPOESS Integrated Program Office data.

[a] Although direct program funding for these instruments was eliminated, the instruments could be reintegrated on NPOESS satellites should other parties choose to fund them. The Nunn-McCurdy decision requires the program office to allow sufficient space on the spacecraft for these instruments and to provide the funding needed to integrate them.

The changes in NPOESS sensors affected the number and quality of the resulting weather and environmental products, called environmental data records or EDRs. In selecting sensors for the restructured program, the agencies placed the highest priority on continuing current operational weather capabilities and a lower priority on obtaining selected environmental and climate measuring capabilities. As a result, the revised NPOESS system has significantly less capability for providing global climate measures than was originally planned. Specifically, the number of EDRs was decreased from 55 to 39, of which six are of a reduced quality. The 39 EDRs that remain include cloud base height, land surface temperature, precipitation type and rate, and sea surface winds. The 16 EDRs that were removed include cloud particle size and distribution, sea surface height, net solar radiation at the top of the atmosphere, and products to depict the electric fields in the space environment. The six EDRs that are of a reduced quality include ozone profile, soil moisture, and multiple products depicting energy in the space environment.

NPOESS Acquisition Restructuring Is Well Under Way, But Key Steps Remain to Be Completed

Since the June 2006 decision to revise the scope, cost, and schedule of the NPOESS program, the program office has made progress in restructuring the satellite acquisition; however, important tasks remain to be done. Restructuring a major acquisition program like NPOESS is a process that involves identifying time-critical and high-priority work and keeping this work moving forward, while reassessing development priorities, inter-dependencies, deliverables, risks, and costs. It also involves revising important acquisition documents including the memorandum of agreement on the roles and responsibilities of the three agencies, the acquisition strategy, the system engineering plan, the test and evaluation master plan, the integrated master schedule defining what needs to happen by when, and the acquisition program baseline. Specifically, the Nunn-McCurdy certification decision required the Secretaries of Defense and Commerce and the Administrator of NASA to sign a revised memorandum of agreement by August 6, 2006. It also required that the program office, Program Executive Officer, and the Executive Committee revise and approve key acquisition documents including the acquisition strategy and system engineering plan by September 1, 2006, in order to proceed with the restructuring. Once these are completed, the program office can proceed to negotiate with its prime contractor on a new program baseline defining what will be delivered, by when, and at what cost.

The NPOESS program office has made progress in restructuring the acquisition. Specifically, the program office has established interim program plans guiding the contractor's work activities in 2006 and 2007 and has made progress in implementing these plans. The program office and contractor also developed an integrated master schedule for the remainder of the program—beyond fiscal year 2007. This integrated master schedule details the steps leading up to launching NPP by September 2009, launching the first NPOESS satellite in January 2013, and launching the second NPOESS satellite in January 2016. Near-term steps include completing and testing the VIIRS, CrIS, and OMPS sensors; integrating these sensors with the NPP spacecraft and completing integration testing; completing the data processing system and integrating it with the command, control, and communications segment; and performing advanced acceptance testing of the overall system of systems for NPP.

However, key steps remain for the acquisition restructuring to be completed. Although the program office made progress in revising key acquisition documents, including the system engineering plan, the test and evaluation master plan, and the acquisition strategy plan, it has not yet obtained the approval of the Secretaries of Commerce and Defense and the Administrator of NASA on the memorandum of agreement among the three agencies, nor has it obtained the approval of the NPOESS Executive Committee on the other key acquisition documents. As of June 2007, these approvals are over nine months past due. Agency officials noted that the September 1, 2006, due date for the key acquisition documents was not realistic given the complexity of coordinating documents among three different agencies.

Finalizing these documents is critical to ensuring interagency agreement and will allow the program office to move forward in completing other activities related to restructuring the program. These other activities include completing an integrated baseline review with the contractor to reach agreement on the schedule and work activities, and finalizing changes to the NPOESS development and production contract. Program costs are also likely to be adjusted during upcoming negotiations on contract changes—an event that the Program Director expects to occur by July 2007. Completion of these activities will allow the program office to lock down a new acquisition baseline cost and schedule. Until key acquisition documents are finalized and approved, the program faces increased risk that it will not be able to complete important restructuring activities in time to move forward in fiscal year 2008 with a new program baseline in place. This places the NPOESS program at risk of continued delays and future cost increases.

Progress Has Been Made in Establishing an Effective NPOESS Management Structure, But Executive Turnover Increases Risks and Staffing Problems Remain

The NPOESS program has made progress in establishing an effective management structure, but—almost a year after this structure was endorsed during the Nunn-McCurdy certification process—the Integrated Program Office still faces staffing problems. Over the past few years, we and others have raised concerns about management problems at all levels of the NPOESS program, including subcontractor and contractor management, program office management, and executive-level management.[12] Two independent review teams also noted a shortage of skilled program staff, including budget analysts and system engineers. Since that time, the NPOESS program has made progress in establishing an effective management structure—including establishing a new organizational framework with increased oversight by program executives, instituting more frequent subcontractor, contractor, and program reviews, and effectively managing risks and performance. However, DOD's plans for reassigning the Program Executive Officer in the summer of 2007 increase the program's risks. Additionally, the program lacks a staffing process that clearly identifies staffing needs, gaps, and plans for filling those gaps. As a result, the program office has experienced delays in getting core management activities under way and lacks the staff it needs to execute day-to-day management activities.

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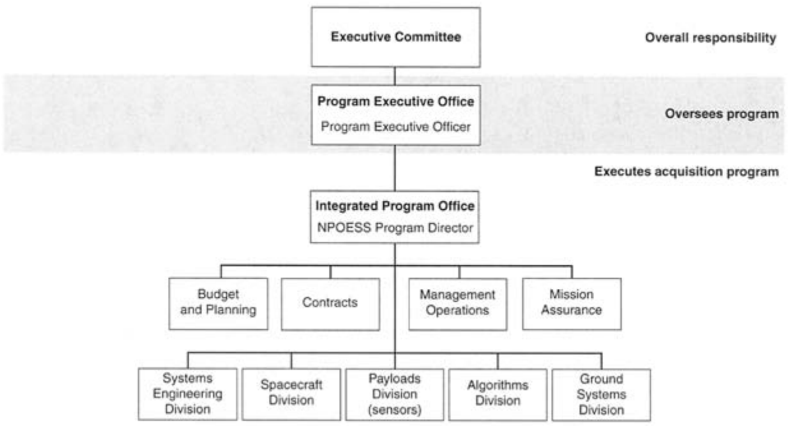
[12] GAO–06–249T; U.S. Department of Commerce, Office of the Inspector General, *Poor Management Oversight and Ineffective Incentives Leave NPOESS Program Well Over Budget and Behind Schedule,* OIG–17794–6–0001/2006 (Washington, D.C.: May 2006). In addition, two independent teams reviewed the NPOESS program in 2005: A NASA-led Independent Review Team investigated problems with the VIIRS sensor and the impact on NPP, and a DOD-led Independent Program Assessment Team assessed the broader NPOESS program. The teams briefed the NPOESS Executive Committee on their findings in August 2005 and November 2005, respectively.

NPOESS Program Has Made Progress in Establishing an Effective Management Structure and Increasing Oversight Activities, But Executive Turnover Will Increase Program Risks

The NPOESS program has made progress in establishing an effective management structure and increasing the frequency and intensity of its oversight activities. Over the past few years, we and others have raised concerns about management problems at all levels of management on the NPOESS program, including subcontractor and contractor management, program office management, and executive-level management. In response to recommendations made by two different independent review teams, the program office began exploring options in late 2005 and early 2006 for revising its management structure.

In November 2005, the Executive Committee established and filled a Program Executive Officer position, senior to the NPOESS Program Director, to streamline decision making and to provide oversight to the program. This Program Executive Officer reports directly to the Executive Committee. Subsequently, the Program Executive Officer and the Program Director proposed a revised organizational framework that realigned division managers within the Integrated Program Office responsible for overseeing key elements of the acquisition and increased staffing in key areas. In June 2006, the Nunn-McCurdy certification decision approved this new management structure and the Integrated Program Office implemented it. Figure 1 provides an overview of the relationships among the Integrated Program Office, the Program Executive Office, and the Executive Committee, as well as key divisions within the program office.

Figure 1: Overview of New NPOESS Management Structure



Source: NOAA.

Operating under this new management structure, the program office implemented more rigorous and frequent subcontractor, contractor, and program reviews, improved visibility into risk management and mitigation activities, and institutionalized the use of earned value management techniques to monitor contractor performance. In addition to these program office activities, the Program Executive Officer implemented monthly program reviews and increased the frequency of contacts with the Executive Committee. The Program Executive Officer briefs the Executive Committee in monthly letters, apprising committee members of the program's status, progress, risks, and earned value, and the Executive Committee now meets on a quarterly basis—whereas in the recent past, we reported that the Executive Committee had met only five times in two years.[13]

Although the NPOESS program has made progress in establishing an effective management structure, this progress is currently at risk. We recently reported that DOD space acquisitions are at increased risk due in part to frequent turnover in leadership positions, and we suggested that addressing this will require DOD to consider matching officials' tenure with the development or delivery of a product.[14] In March 2007, NPOESS program officials stated that DOD is planning to reassign the recently appointed Program Executive Officer in the summer 2007 as part of this executive's natural career progression. As of June 2007, the Program Executive Officer has held this position for 19 months. Given that the program is currently still being restructured, and that there are significant challenges in being able to meet critical deadlines to ensure satellite data continuity, such a move adds unnecessary risk to an already risky program.

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[13] GAO–06–249T.

NPOESS Program Has Filled Key Vacancies but Lacks a Program-wide Staffing Process

The NPOESS program office has filled key vacancies but lacks a staffing process that identifies program-wide staffing requirements and plans for filling those needed positions. Sound human capital management calls for establishing a process or plan for determining staffing requirements, identifying any gaps in staffing, and planning to fill critical staffing gaps. Program office staffing is especially important for NPOESS, given the acknowledgment by multiple independent review teams that staffing shortfalls contributed to past problems. Specifically, these review teams noted shortages in the number of system engineers needed to provide adequate oversight of subcontractor and contractor engineering activities and in the number of budget and cost analysts needed to assess contractor cost and earned value reports. To rectify this situation, the June 2006 certification decision directed the Program Director to take immediate actions to fill vacant positions at the program office with the approval of the Program Executive Officer.

Since the June 2006 decision to revise NPOESS management structure, the program office has filled multiple critical positions, including a budget officer, a chief system engineer, an algorithm division chief, and a contracts director. In addition, on an ad hoc basis, individual division managers have assessed their needs and initiated plans to hire staff for key positions. However, the program office lacks a program-wide process for identifying and filling all needed positions. As a result, division managers often wait months for critical positions to be filled. For example, in February 2006, the NPOESS program estimated that it needed to hire up to 10 new budget analysts. As of September 2006, none of these positions had been filled. As of April 2007, program officials estimated that they still needed to fill five budget analyst positions, five systems engineering positions, and 10 technical manager positions. The majority of the vacancies—four of the five budget positions, four of the five systems engineering positions, and eight of the 10 technical manager positions—are to be provided by NOAA. NOAA officials noted that each of these positions is in some stage of being filled—that is, recruitment packages are being developed or reviewed, vacancies are being advertised, or candidates are being interviewed, selected, and approved.

The program office attributes its staffing delays to not having the right personnel in place to facilitate this process, and it did not even begin to develop a staffing process until November 2006. Program officials noted that the tri-agency nature of the program adds unusual layers of complexity to the hiring and administrative functions because each agency has its own hiring and performance management rules. In November 2006, the program office brought in an administrative officer who took the lead in pulling together the division managers' individual assessments of needed staff and has been working with the division managers to refine this list. This new administrative officer plans to train division managers in how to assess their needs and to hire needed staff, and to develop a process by which evolving needs are identified and positions axe filled. However, there is as yet no date set for establishing this basic program-wide staffing process. As a result of the lack of a program-wide staffing process, there has been an extended delay in determining what staff is needed and in bringing those staff on board; this has resulted in delays in performing core activities, such as establishing the program office's cost estimate and bringing in needed contracting expertise. Additionally, until a program-wide staffing process is in place, the program office risks not having the staff it needs to execute day-to-day management activities.

In commenting on a draft of our report, Commerce stated that NOAA implemented an accelerated hiring model. More recently, the NPOESS program office reported that several critical positions were filled in April and May 2007. However, we have not yet evaluated NOAA's accelerated hiring model and, as of June 2007, over 10 key positions remain to be filled.

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[14] GAO, *Space Acquisitions: Improvements Needed in Space Acquisitions and Keys to Achieving Them,* GAO–06–626T (Washington, D.C.: Apr. 6, 2006).

Major Program Segments Are Under Development, But Significant Risks Remain

Major segments of the NPOESS program—the space segment and ground systems segment—are under development; however, significant problems have occurred and risks remain. The program office is aware of these risks and is working to mitigate them, but continued problems could affect the program's overall cost and schedule. Given the tight time frames for completing key sensors, integrating them on the NPP spacecraft, and developing, testing, and deploying the ground-based data processing systems, it will be important for the NPOESS Integrated Program Office, the Program Executive Office, and the Executive Committee to continue to provide close oversight of milestones and risks.

Space Segment—Progress Made, But Key Sensors Continue to Face Major Risks

The space segment includes the sensors and the spacecraft. Four sensors are of critical importance—VIIRS, CrIS, OMPS, and ATMS—because they are to be launched on the NPP satellite in September 2009. Initiating work on another sensor, the Microwave imager/sounder, is also important because this new sensor—replacing the canceled CMIS sensor—will need to be developed in time for the second NPOESS satellite launch. Over the past year, the program made progress on each of the sensors and the spacecraft. However, two sensors, VIIRS and CrIS, have experienced major problems. The status of each of the components of the space segment is described in Table 5.

Table 5: Status of Selected Components of the Space Segment, as of April 2007

Space segment component	Risk level	Status
VIIRS	High	VIIRS development has continued in 2006 and in early 2007. In December 2006, the contractor completed environmental tests of VIIRS's engineering design unit (a prototype) and identified three problems.[a] While these problems were being studied, the program office approved the delivery of the engineering unit to the subcontractor responsible for integration and testing on NPP. In late February 2007, program officials determined that the contractor was able to mitigate all but one of the problems, and they approved the flight unit to proceed to system level integration with a goal of resolving the final problem before a technical readiness review milestone. VIIRS flight unit is scheduled to be delivered to NPP by July 2008.
CrIS	High	Development of CrIS was put on hold in October 2006 when the flight unit designated to go on NPP experienced a major structural failure during its vibration testing. As of March 2007, a failure review board established by the contractors and the NPOESS program office identified causes for failure and has planned an approach to completing flight unit development and delivery for NPP. The review board has also initiated inspections of all sensor modules and subsystems for damage. The program office expects to restart acceptance testing in July 2007, and the CrIS flight unit is expected to be delivered to NPP by February 2008.
OMPS	Moderate	As part of the Nunn-McCurdy certification in June 2006, one element of the OMPS sensor, called OMPS (limb), was removed from the program. In February 2007, program officials agreed to reintegrate OMPS (limb) on NPP if NOAA and NASA would fund it. This funding was approved in early April 2007. OMPS is currently on schedule for delivery to NPP by May 2008; however, there are concerns that the OMPS flight unit delivery will be so late in the integration testing process that there could be an insufficient schedule margin should a problem arise.
ATMS	Low	The ATMS flight unit for NPP was developed by a NASA contractor and delivered to the program in October 2005. NASA integrated the flight unit on the spacecraft and is awaiting delivery of the other sensors in order to complete integration testing.
Microwave imager/ sounder	Not yet rated	A new microwave imager/sounder sensor is being planned to replace the cancelled CMIS sensor. It is planned to be ready for the launch on the second NPOESS satellite. In October 2006, the program office issued a request for information seeking industry ideas for the design of the new sensor. The program office anticipates awarding a contract to develop the sensor by October 2008.
Spacecraft	Low	The development of the spacecrafts for NPP and NPOESS are on track. The NPP spacecraft was completed in June 2005. Integration testing will be conducted once the NPP sensors are delivered. Early issues with the NPOESS spacecraft (including issues with antennas and a data storage unit) have been resolved; however, risks remain that could delay the completion of the spacecraft. A key risk involves delays in the delivery of the solar array, which may arrive too late to be included in some key testing. Other risks associated with the electrical power subsystem are taking longer than anticipated to resolve.

Source: GAO analysis of NPOESS Integrated Program Office data.

[a] The three problems are (1) band-to-band co-registration, an issue in which band registration shifts with different temperatures; (2) cross-talk, which involves information from sensor cells leaking into other cells; and (3) line-spread function issues, in which the instrument's focus changes with changes in temperature.

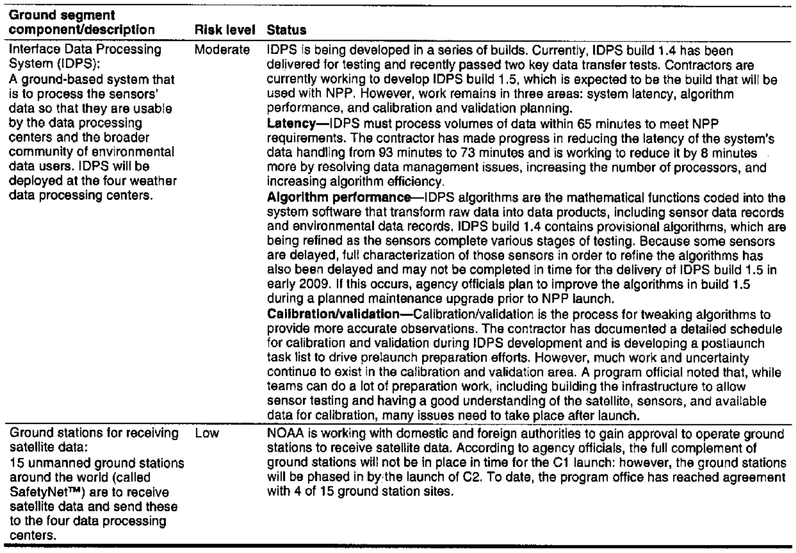
Program officials regularly track risks associated with various NPOESS components and work to mitigate them. Having identified both VIIRS and CrIS as high risk, OMPS as moderate risk, and the other components as low risk, the program office is working closely with the contractors and subcontractors to resolve sensor problems. Program officials have identified work-grounds that will allow them to move forward in testing the VIIRS engineering unit and have approved the flight unit to proceed to a technical readiness review milestone. Regarding CrIS, as of March 2007, a failure review board identified root causes of its structural failure, identified plans for resolving them, and initiated inspections of sensor modules and subsystems for damage. An agency official reported that there is sufficient funding in the fiscal year 2007 program office's and contractor's management reserve funds to allow for troubleshooting both VIIRS and CrIS problems. However, until the CrIS failure review board fully determines the amount of rework that is necessary to fix the problems, it is unknown if additional funds will be needed or if the time frame for CrIS's delivery will be delayed. According to agency officials, CrIS is not on the program schedule's critical path, and there is sufficient schedule margin to absorb the time it will take to conduct a thorough failure review process.

Managing the risks associated with the development of VIIRS and CrIS is of particular importance because these components are to be demonstrated on the NPP satellite, currently scheduled for launch in September 2009. Any delay in the NPP launch date could affect the overall NPOESS program, because the success of the program depends on the lessons learned in data processing and system integration from the NPP satellite. Additionally, continued sensor problems could lead to higher final program costs.

Ground Segment-Progress Has Been Made, But Work Remains

Development of the ground segment—which includes the interface data processing system, the ground stations that are to receive satellite data, and the ground-based command, control, and communications system—is under way and on track. However, important work pertaining to developing the algorithms that translate satellite data into weather products within the integrated data processing segment remains to be completed. Table 6 describes each of the components of the ground segment and identifies the status of each.

Table 6: Status of Ground Segment Components



Ground segment component/description	Risk level	Status
Interface Data Processing System (IDPS): A ground-based system that is to process the sensors' data so that they are usable by the data processing centers and the broader community of environmental data users. IDPS will be deployed at the four weather data processing centers.	Moderate	IDPS is being developed in a series of builds. Currently, IDPS build 1.4 has been delivered for testing and recently passed two key data transfer tests. Contractors are currently working to develop IDPS build 1.5, which is expected to be the build that will be used with NPP. However, work remains in three areas: system latency, algorithm performance, and calibration and validation planning. **Latency**—IDPS must process volumes of data within 65 minutes to meet NPP requirements. The contractor has made progress in reducing the latency of the system's data handling from 93 minutes to 73 minutes and is working to reduce it by 8 minutes more by resolving data management issues, increasing the number of processors, and increasing algorithm efficiency. **Algorithm performance**—IDPS algorithms are the mathematical functions coded into the system software that transform raw data into data products, including sensor data records and environmental data records. IDPS build 1.4 contains provisional algorithms, which are being refined as the sensors complete various stages of testing. Because some sensors are delayed, full characterization of those sensors in order to refine the algorithms has also been delayed and may not be completed in time for the delivery of IDPS build 1.5 in early 2009. If this occurs, agency officials plan to improve the algorithms in build 1.5 during a planned maintenance upgrade prior to NPP launch. **Calibration/validation**—Calibration/validation is the process for tweaking algorithms to provide more accurate observations. The contractor has documented a detailed schedule for calibration and validation during IDPS development and is developing a postlaunch task list to drive prelaunch preparation efforts. However, much work and uncertainty continue to exist in the calibration and validation area. A program official noted that, while teams can do a lot of preparation work, including building the infrastructure to allow sensor testing and having a good understanding of the satellite, sensors, and available data for calibration, many issues need to take place after launch.
Ground stations for receiving satellite data: 15 unmanned ground stations around the world (called SafetyNet™) are to receive satellite data and send these to the four data processing centers.	Low	NOAA is working with domestic and foreign authorities to gain approval to operate ground stations to receive satellite data. According to agency officials, the full complement of ground stations will not be in place in time for the C1 launch: however, the ground stations will be phased in by the launch of C2. To date, the program office has reached agreement with 4 of 15 ground station sites.

Source: GAO analysis of NPOESS Integrated Program Office data.

The NPOESS program office plans to continue to address risks facing IDPS development. Specifically, the IDPS team is working to reduce data processing delays by seeking to limit the number of data calls, improve the efficiency of the data management system, increase the efficiency of the algorithms, and increase the number of processors. The program office also developed a resource center consisting of a logical technical library, a data archive, and a set of analytical tools to coordinate, communicate, and facilitate the work of algorithm subject matter experts on algorithm development and calibration/validation preparations. Managing the risks associated with the development of the IDPS system is of particular importance because this system will be needed to process NPP data.

Implementation of GAO Recommendations Should Reduce Program Risks

Because of the importance of effectively managing the NPOESS program to ensure that there are no gaps in the continuity of critical weather and environmental observations, in our accompanying report[15] we made recommendations to the Secretaries of Defense and Commerce and to the Administrator of NASA to ensure that the responsible executives within their respective organizations approve key acquisition documents, including the memorandum of agreement among the three agencies, the system engineering plan, the test and evaluation master plan, and the acquisition strategy, as quickly as possible but no later than April 30, 2007. We also recommended that the Secretary of Defense direct the Air Force to delay reassigning the recently appointed Program Executive Officer until all sensors have been delivered to the NPOESS Preparatory Program; these deliveries are currently scheduled to occur by July 2008. We also made two additional recommendations to the Secretary of Commerce to (1) develop and implement a written process for identifying and addressing human capital needs and for streamlining how the program handles the three different agencies' administrative procedures and (2) establish a plan for immediately filling needed positions.

In written comments, all three agencies agreed that it was important to finalize key acquisition documents in a timely manner, and DOD proposed extending the due dates for the documents to July 2, 2007. Because the NPOESS program office intends to complete contract negotiations by July 4, 2007, we remain concerned that any further delays in approving the documents could delay contract negotiations and thus increase the risk to the program.

In addition, the Department of Commerce agreed with our recommendation to develop and implement a written process for identifying and addressing human capital needs and to streamline how the program handles the three different agencies' administrative procedures. The department also agreed with our recommendation to plan to immediately fill open positions at the NPOESS program office. Commerce noted that NOAA identified the skill sets needed for the program and has implemented an accelerated hiring model and schedule to fill all NOAA positions in the NPOESS program. Commerce also noted that NOAA has made NPOESS hiring a high priority and has documented a strategy—including milestones—to ensure that all NOAA positions are filled by June 2007.

DOD did not concur with our recommendation to delay reassigning the Program Executive Officer, noting that the NPOESS System Program Director responsible for executing the acquisition program would remain in place for 4 years. The Department of Commerce also noted that the Program Executive Officer position is planned to rotate between the Air Force and NOAA. Commerce also stated that a selection would be made before the departure of the current Program Executive Officer to provide an overlap period to allow for knowledge transfer and ensure continuity. However, over the last few years, we and others (including an independent review team and the Commerce Inspector General) have reported that ineffective executive-level oversight helped foster the NPOESS program's cost and schedule overruns. We remain concerned that reassigning the Program Executive at a time when NPOESS is still facing critical cost, schedule, and technical challenges will place the program at further risk.

In addition, while it is important that the System Program Director remain in place to ensure continuity in executing the acquisition, this position does not ensure continuity in the functions of the Program Executive Officer. The current Program Executive Officer is experienced in providing oversight of the progress, issues, and challenges facing NPOESS and coordinating with Executive Committee members as well as the Defense acquisition authorities. Additionally, while the Program Executive Officer position is planned to rotate between agencies, the memorandum of agreement documenting this arrangement is still in draft and should be flexible enough to allow the current Program Executive Officer to remain until critical risks have been addressed.

Further, while Commerce plans to allow a period of overlap between the selection of a new Program Executive Officer and the departure of the current one, time is running out. The current Program Executive Officer is expected to depart in early July 2007, and as of early June 2007, a successor has not yet been named. NPOESS is an extremely complex acquisition, involving three agencies, multiple contractors, and advanced technologies. There is not sufficient time to transfer knowledge and develop the sound professional working relationships that the new Program Executive Officer will need to succeed in that role. Thus, we remain convinced that given NPOESS current challenges, reassigning the current Program Executive Officer at this time would not be appropriate.

In summary, NPOESS restructuring is well under way, and the program has made progress in establishing an effective management structure. However, key steps remain in restructuring the acquisition, including completing important acquisition documents such as the system engineering plan, the acquisition program baseline, and the memorandum of agreement documenting the three agencies' roles and responsibilities. Until these key documents are finalized, the program is unable to finalize plans for restructuring the program. Additionally, the program office continues to have difficulty filling key positions and lacks a program-wide staffing process. Until the program establishes an effective and repeatable staffing process, it will have difficulties in identifying and filling its staffing needs in a timely manner. Having insufficient staff in key positions impedes the program office's ability to conduct important management and oversight activities, including revising cost and schedule estimates, monitoring progress, and managing technical risks. The program faces even further challenges if DOD proceeds with plans to reassign the Program Executive Officer this summer. Such a move would add unnecessary risk to an already risky program.

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[15] GAO–07–498.

In addition, the likelihood exists that there will be further cost increases and schedule delays because of technical problems on key sensors and pending contract negotiations. Major program segments—including the space and ground segments—are making progress in their development and testing. However, two critical sensors have experienced problems and are considered high risk, and risks remain in developing and implementing the ground-based data processing system. Given the tight time frames for completing key sensors, integrating them, and getting the ground-based data processing systems developed, tested, and deployed, continued close oversight of milestones and risks is essential to minimize potential cost increases and schedule delays.

Mr. Chairman, this concludes my statement. I would be happy to answer any questions that you or Members of the Committee may have at this time.

Other key contributors to this testimony include Colleen Phillips (Assistant Director), Carol Cha, and Teresa Smith.

BIOGRAPHY FOR DAVID A. POWNER

Experience

Twenty years' experience in information technology issues in both public and private sectors.

Education

Business Administration, University of Denver

Senior Executive Fellows Program, Harvard University, John F. Kennedy School of Government

Dave is Director of IT Management Issues at the U.S. Government Accountability Office. He is currently responsible for a large segment of GAO's information technology (IT) work, including systems development, IT investment management, health IT, and cyber critical infrastructure protection reviews.

In the private sector, Dave has held several executive-level positions in the telecommunications industry, including overseeing IT and financial internal audits, and software development associated with digital subscriber lines (DSL).

At GAO, Dave has led teams reviewing major IT modernization efforts at Cheyenne Mountain Air Force Station, the National Weather Service, the Federal Aviation Administration, and the Internal Revenue Service. These reviews covered many information technology areas including software development maturity, information security, and enterprise architecture.

Chairman LAMPSON. Thank you, Mr. Powner, for your testimony and for being here.

General Mashiko, you are recognized for five minutes.

STATEMENT OF BRIGADIER GENERAL SUSAN K. MASHIKO, PROGRAM EXECUTIVE OFFICER FOR ENVIRONMENTAL SATELLITES, UNITED STATES AIR FORCE

Brigadier General MASHIKO. Chairman Lampson, Ranking Member Inglis, and Committee Members, thank you for this opportunity to address you today.

I am responsible for a portfolio of a program that includes the orbital operations of the Defense Meteorological Satellite Program and the development of the NPOESS program. I report to the Administrator of NASA, the Under Secretary of the Air Force, and the Under Secretary of Commerce for Oceans and Atmosphere. I appreciate this opportunity to discuss with you the status of the NPOESS program and thank you for your continued interest and support.

In response to the questions that you sent in your letter of invitation concerning the latest status of the program, the first question was when will the new program baseline be finalized, and when will the contractor renegotiations be completed. A new program baseline is finalized. The integrated baseline review, our final step, was completed last week, and the restructure proposal was received from the contractor, and fact finding is, in fact, complete. Negotiations should conclude with a contract in July.

Your second question was what is the current status of the key NPOESS sensors, and when will the flight units be delivered for incorporation on NPP. The two key sensors as mentioned by David Powner, are, in fact, the Visible/Infrared Radiometer Suite, or VIIRS, and the Cross-track Infrared Sounder, or CrIS. Let me address the VIIRS first.

I commissioned an independent review team to look at the sufficiency of the VIIRS design. The team came back—when they reported out—that said the design was basically sound and will produce operational weather data to the expected levels. The flight unit has recently completed the test readiness review, and we will soon initiate acceptance testing leading to its delivery in the summer of 2008, for NPP.

With respect to the Cross-track Infrared Sounder, or CrIS, it experienced a structural failure in the final seconds of vibration testing in October. A Joint Failure Review Board has determined the root cause of this failure, and a systemic exoneration of all components is ongoing. This thorough process has produced confidence in the flight unit, and this unit will resume testing at the system level upon receipt of a strengthened frame, supporting delivery in the summer of 2008.

Your third question was what progress has been made on defining the microwave sensor that replaces the canceled CMIS instrument. A Request For Information, or RFI, was released to industry late last year and based upon the data received from that data call, a detailed specification is being developed that will meet or exceed the threshold requirements for this instrument. A new microwave sensor program will be reviewed by my replacement and the EXCOM[9] in September and, with the EXCOM's concurrence, a request for proposal will be released in FY 2008.

Your final question was are the program and instrument contractors currently meeting the milestones set out in the fiscal year 2007 interim program plan. In short, yes. The contractors are doing well in meeting their cost and schedule commitments for the fiscal year 2007 interim program plan. Northrop Grumman Space Technology (NGST) is currently slightly ahead of plan, having completed 122 milestones, where only 120 were scheduled.

With respect to the GAO report, it should be noted that the GAO staff has maintained a close vigilance of the NPOESS program and attends my monthly program management reviews. Their understanding of the program was evident in their recent report, and we completely agree that technical challenges and risks remain. And we are gratified to see that the GAO notes that management changes put in place over the last year are paying dividends. Management changes that we and the NPOESS prime contractor, NGST, have undertaken are widespread and affect every aspect of the execution of this complex satellite development. In fact, it is a complete change of approach as we move "back to basics."

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[9] EXCOM: Executive Committee Members of the NPOESS Program.

This is as the government assumes a far more active role in the verification of all data and test results. This required significant staff additions that have been strongly supported by all three agencies. They are looking for truly talented and experienced space people, and they are truly hard to come by. We currently have a few vacancies in work but all necessary actions are progressing.

In conclusion, NPOESS is one of the most complex environmental satellite systems ever developed. The management changes that the Government and our prime contractor have put in place are making a difference. But please remember we are building some truly complex instruments. We have structured a stringent test program to uncover problems on the ground rather than in orbit. We are structuring the program to respond rapidly to any problems with sufficient margin to accommodate the difficulties that will arise.

Thank you for the opportunity to speak to you today.

[The prepared statement of Brigadier General Mashiko follows:]

PREPARED STATEMENT OF BRIGADIER GENERAL SUSAN K. MASHIKO

Introduction

Chairmen Lampson and Miller, Ranking Members Inglis and Sensenbrenner, and Members of the Committee, I appreciate the opportunity to provide an update of our progress on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and to comment on the recommendations of the recent Government Accountability Office (GAO) report.

I am Brigadier General Susan K. Mashiko, Program Executive Officer for Environmental Satellites. I report to the Executive Committee of the NPOESS Program which is comprised of the Administrator of the National Aeronautics and Space Administration (NASA), the Under Secretary of Commerce for Oceans and Atmosphere, and the Under Secretary of the Air Force. I oversee the day-to-day operations of the NPOESS Program and interface with other government agencies and departments and international partners. I am here today to give you an update on the program status and to address the recent GAO report.

Program Background

First let me review what NPOESS is for the new Committee Members. In 1994, after a thorough review and serious consideration, President Clinton directed the merger of the military and civilian operational polar satellite programs. This new program, NPOESS, is responsible for developing the next generation of polar satellites and sensors. The program was designed as a series of six satellites and a total of 10 environmental sensors, five of which represent significant advances over current operational satellite technology. The new NPOESS sensors will provide higher quality data than the current operational meteorological satellites leading to more sophisticated environmental models for weather, climate and the oceans.

The NPOESS Preparatory Project (NPP) is a joint mission involving the National Aeronautics and Space Administration (NASA) and the NPOESS Integrated Program Office (IPO). The NPP mission will collect and distribute remotely-sensed land, ocean, and atmospheric data to the meteorological and global climate change communities as the responsibility for these measurements transitions from NASA's existing Earth-observing missions (e.g., Aqua, Terra and Aura) to the NPOESS. NPP also provides risk reduction by testing several new sensors in space, ensure the ground control systems work properly, and allow us time to assimilate the new data into computer weather models before launch of the first operational NPOESS satellite. NPP will provide atmospheric and sea surface temperatures, humidity sounding, land and ocean biological productivity, and cloud and aerosol properties.

NPOESS is being acquired using DOD acquisition authorities and is managed by an Integrated Program Office (IPO). In 2002, Northrop Grumman was selected as the NPOESS prime contractor for spacecraft development, ground systems, sensor integration, and operations.

As many on this committee are aware, in December 2005, the IPO notified the Air Force that projected cost overruns would exceed the 25 percent threshold triggering a breach of the Nunn-McCurdy statute. In June 2006, following the Nunn-McCurdy certification and resulting restructure of the NPOESS program we are moving forward with two fewer satellites, fewer sensors, less risk, cost increases, but also with increases in our confidence levels for timely delivery of core weather forecasting capabilities, accompanied by a significant reduction in its climate monitoring capabilities.

The GAO report properly notes that the NPOESS program has made progress since the June 2006 Nunn-McCurdy certification and we completely agree that technical challenges and risk still remain. The three agencies involved in the NPOESS development, the Department of Commerce (DOC), the Department of Defense (DOD), and NASA continue to regularly monitor the development of the NPOESS program. They commit their best talent and participate in the decision-making process through the NPOESS Executive Committee (EXCOM). The significant management changes and the reduced risk profile resulting from the Nunn-McCurdy certification and subsequent restructure have had major positive impacts on the program. NPOESS still remains, however, the most complex environmental satellite system ever developed.

Over the last eighteen months, the program has taken a disciplined acquisition approach to the simultaneous execution of the development program and program restructure. Through the creation of discrete, measurable, development milestones the NPOESS IPO has fundamentally revamped their management style to one of aggressive oversight of the contractor. This “back-to-basics” approach facilitated the reorganization of both government and industry management teams while permitting risk reduction to move apace. Most metrics for cost and schedule goals have been achieved for this period. As in all developmental programs, NPOESS has uncovered and addressed new challenges.

Program Status

The Cross-track Infrared Sounder (CrIS) is intended to provide improved measurements of the temperature and moisture profiles in the atmosphere allowing forecasters to improve both global and regional predictions of weather patterns, storm tracks, and precipitation. In October, 2006, CrIS experienced a challenge when a structural component broke in the final moments of its vibration test. The failure was fully analyzed by a Tri-Agency and industry team and corrective actions are underway. This instrument has sufficient schedule margin to ensure that the projected 2009 launch of the NPOESS Preparatory Project (NPP) and the first NPOESS satellite in 2013 will not, at this time, be affected.

The Visible/Infrared Imager/Radiometer Suite (VIIRS) collects high resolution atmospheric imagery and generates a variety of applied products, including visible and infrared imaging of hurricanes and detection of wildland fires, smoke, and atmospheric aerosols. The VIIRS instrument, which was one of the principal contributors to the Nunn-McCurdy breach, has completed extensive reviews by both a government team from the NPOESS program and an independent team of outside experts. Corrective actions for all identified VIIRS instrument problems are underway. One major technical issue, optical cross talk, remains and we are pursing several potential solutions. The VIIRS product most at risk at this point is ocean color, but there are also concerns about the atmospheric aerosol products should the cross talk problem not be resolved. This key instrument will continue to be the focus of intense management attention for the foreseeable future.

The NPOESS IPO has issued a request for information for a Microwave Imager/Sounder (MIS), a smaller, less complex sensor than the original Conical-scanning Microwave Imager/Sounder (CMIS). The MIS is still intended to provide data for a variety of products including sea surface winds. The MIS is scheduled to first fly on the second NPOESS spacecraft and then on all subsequent missions. A final acquisition strategy decision is anticipated by September 2007, at which time cost and schedule information will be available.

A number of sensors were de-manifested from NPOESS as a result of the Nunn-McCurdy process, especially those oriented towards climate measurements. At the initiative of the Office of Science and Technology Policy (OSTP), NASA and NOAA are working together to identify what might be required to provide flight opportunities for the de-manifested sensors—either on NPOESS platforms or some other method—to assure continuity of key climate parameters such as Earth radiation budget, solar irradiance, sea surface topography, ozone vertical profile, and aerosol optical properties. OSTP will work with the agencies and the Office of Management and Budget to determine if the required resources can be identified in the time frame required to protect the climate data records.

The ground and data processing system continues to make excellent progress. The NOAA Satellite Operations Facility is up and running and flying the heritage NOAA and DOD satellites. The command and control software has been fully tested. Early versions of the operational data processing system are being tested with real data delivered from satellites currently in orbit.

The program restructure proposal, which culminates 10 months of intensive government and industry effort, details all aspects of the NPOESS program and has been received from Northrop Grumman Space Technology. This proposal provides detailed planning, scheduling and resource allocation for the next ten years. The proposal is presently in the negotiation process and is on track for a late summer 2007 award. Concurrently, the government is conducting an Integrated Baseline Review (IBR), which will provide the government with additional confidence in the Northrop Grumman scheduling and resource allocation process.

The Ozone Mapping and Profiler Suite (OMPS) Limb instrument will measure the vertical distribution of stratospheric ozone with high resolution; and it will complement observations from existing NPOESS sensors most notably the column and low resolution profile measurements from the OMPS Nadir instrument. In response to the climate science community, NOAA and NASA recently announced that the OMPS–Limb will be re-manifested with the OMPS Nadir onto the NPP in time to meet the scheduled 2009 launch date. NOAA and NASA have agreed to equally share the cost of restoring the OMPS–Limb onto the NPP spacecraft. The OMPS–Limb will measure the vertical distribution of ozone and it will complement observations from existing NPOESS sensors.

Government Accountability Office (GAO) Recommendations

I would like to commend the GAO staff for their collaborative approach to the NPOESS audits. I appreciate their commitment to providing recommendations and findings that will assist the NPOESS partners. While official comments have been provided to GAO, I'd like to take the opportunity to provide a synopsis of our responses and the status of addressing the recommendations.

The GAO report emphasizes the need to expeditiously complete the documentation directed by the Acquisition Decision Memorandum for the NPOESS program. The staffs of the three parent agencies have been fully consulted during the development of these documents. These Tri-Agency documents will be fully executed by late summer. In the interim, administration of the NPOESS program and the contract is not being adversely affected.

The GAO report also recommends that the Secretary of Defense delay the reassignment of the NPOESS PEO. While I cannot speak for the DOD, I can state that the NPOESS PEO position has long been planned to rotate between the Air Force and NOAA. As part of this planned rotation, the next NPOESS PEO will be a NOAA employee. A selection is planned prior to my departure in summer 2007 and is being timed to provide a transition period that will facilitate knowledge transfer and ensure continuity.

The GAO report recommends that NOAA address the human capital needs for the NPOESS program and that it immediately fill needed positions. NOAA has implemented an accelerated hiring model and corresponding schedule to fill all NOAA positions identified in the GAO report and all positions needed by the NPOESS program. All three agencies are working in concert and we have identified the positions to be filled, the hiring strategy, and other program human capital needs. Regular progress reporting on the status of filling these positions occurs, and the NPOESS System Program Director reports at monthly meetings with the PEO. NOAA has established a complementary, documented strategy with milestones to ensure that all needed positions are filled. We are working very closely with the NOAA Workforce Management Office to ensure obstacles to the hiring process are identified and addressed immediately. The five additional NASA positions were identified as needed following the Nunn-McCurdy certification have since been filled.

The NPOESS Tri-Agency partners are working very hard to ensure the actions required to address these recommendations are implemented in a timely manner to improve our ability to successfully manage the program.

Summary

In summary, the management changes that were established over the last year have taken hold and are working at both the government and contractor program management offices. The test program is identifying problems and that is just what it is designed to do. We have added one of the de-manifested instruments onto the NPP; this type of add-back, if continued onto the NPOESS platforms as envisioned by the Nunn-McCurdy analysis. The NPOESS program will continue instrument development to meet the 2009 NPP launch and the 2013 launch of the first NPOESS satellite.

Thank you for the opportunity to speak with you today and I am prepared to answer your questions.

BIOGRAPHY FOR BRIGADIER GENERAL SUSAN K. MASHIKO

Brig. Gen. Susan K. Mashiko is Program Executive Officer for Environmental Satellites, which includes the National Polar-orbiting Operational Environmental Satellite System Integrated Program Office in Silver Spring, Md. The NPOESS IPO is a Presidentially-directed unit reporting to the Under Secretary of Defense for Acquisition, Technology and Logistics, the Under Secretary of Commerce, and the Deputy NASA Administrator. NPOESS provides a single national capability to provide global environmental data, meeting military and civil operational needs of the Department of Defense and Department of Commerce. The NPOESS program office develops, acquires and operates space and ground systems valued more than $7 billion. This portfolio also includes the operations of the Defense Meteorological Satellite Program, which provides environmental data to the joint warfighter.

General Mashiko was born in Glendale, Calif., and entered the Air Force as a graduate of the U.S. Air Force Academy where she earned a Bachelor's degree in aeronautical engineering. Her career has spanned a wide variety of space and acquisition assignments, including Chief of the Programs Division in the Office of Special Projects, executive officer to the DOD Space Architect and Program Manager for the Atlas V Program. She has also served as Director of the Evolved Expendable Launch Vehicle System Program, Deputy Director of the NPOESS Program and Vice Commander of Air Armament Center.

EDUCATION

1980—Bachelor of Science degree in aeronautical engineering, U.S. Air Force Academy, Colorado Springs, Colo.

1982—Squadron Officer School, by correspondence

1986—Master of Science degree in electrical engineering, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio

1993—Air Command and Staff College, Maxwell AFB, Ala.

1998—Master of Science degree in national resource strategy, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.

1998—Senior Acquisition Course, National Defense University, Fort Lesley J. McNair, Washington, D.C.

ASSIGNMENTS

1. June 1980–May 1984, Chief, Anti-Satellite Payload Avionics Branch, Directorate of ASAT Systems, Headquarters Space Division, Los Angeles Air Force Station, Calif.
2. May 1984–April 1986, graduate student, Air Force Institute of Technology, Wright-Patterson AFB, Ohio.
3. April 1986–March 1989, Chief, Systems Implementation Branch, Directorate of Applied Technology, Office of Special Projects, Office of the Secretary of the Air Force, Los Angeles AFB, Calif.
4. March 1989–August 1992, Chief, Programs Division, Directorate of Applied Technology, Office of Special Projects, Office of the Secretary of the Air Force, Los Angeles AFB, Calif.
5. August 1992–June 1993, student, Air Command and Staff College, Maxwell AFB, Ala.
6. June 1993–December 1994, special assistant, Space Policy and Plans, Directorate of Space Programs, Assistant Secretary of the Air Force for Acquisition, Washington, D.C.

7. December 1994–January 1996, executive officer, Directorate of Space Programs, Assistant Secretary of the Air Force for Acquisition, Washington, D.C.
8. January 1996–May 1996, executive officer, Department of Defense Space Architect, Washington, D.C.
9. May 1996–August 1997, policy and issues analyst, Secretary of the Air Force Staff Group, Office of the Secretary of the Air Force, Washington, D.C.
10. August 1997–June 1998, student, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.
11. July 1998–March 2000, Program Manager, Atlas V Program, Evolved Expendable Launch Vehicle System Program Office, Space and Missile Systems Center, Los Angeles AFB, Calif.
12. March 2000–May 2002, Deputy Director, Evolved Expendable Launch Vehicle System Program, Space and Missile Systems Center, Los Angeles AFB, Calif.
13. May 2002–December 2003, Director, Evolved Expendable Launch Vehicle System Program, Space and Missile Systems Center, Los Angeles AFB, Calif.
14. January 2004–February 2005, Chief, Director's Special Action Staff, Office of the Director, National Reconnaissance Office, Washington, D.C.
15. February 2005–August 2005, Deputy Director, National Polar-orbiting Operational Environmental Satellite Systems Program, Air Force Element, Silver Spring, Md.
16. August 2005–January 2006, Vice Commander, Air Armament Center, Eglin AFB, Fla.
17. January 2006–present, Program Executive Officer for Environmental Satellites, Silver Spring, Md.

MAJOR AWARDS AND DECORATIONS

Legion of Merit
Defense Meritorious Service Medal
Meritorious Service Medal
Joint Service Commendation Medal
Air Force Commendation Medal

OTHER ACHIEVEMENTS

1998, John J. Welch Award for Excellence in Acquisition Management, Secretary of the Air Force

1998, Strategic Acquisition Reform Award for Contracting Excellence, Secretary of the Air Force

1999, David W. Packard Award for Acquisition Excellence, Department of Defense

2003, Unit of the Year (Director), Air Force Association

EFFECTIVE DATES OF PROMOTION

Second Lieutenant—May 28, 1980
First Lieutenant—May 28, 1982
Captain—May 28, 1984
Major—Oct. 1, 1991
Lieutenant Colonel—Nov. 1, 1996
Colonel—March 1, 2001
Brigadier General—Sept. 7, 2006

DISCUSSION

Chairman LAMPSON. Thank you very much. We will now go into the questioning, the first round of questions, and I will recognize myself for five minutes.

RESTORING ORPHAN SENSORS

Dr. Marburger, as you note in your testimony we have restored OMPS–Limb to the Preparatory Project. The Limb sensor is an important component in monitoring the recovery of the ozone layer, which may require collecting data out until 2050. Are we prepared to put the full ozone sensor back aboard the satellites: according to the information given to the Committee, removing them from the program had a $57 million impact or affect?

Dr. MARBURGER. The short answer to that question, Congressman, is yes. We are committed. It is rated as an important sensor, and that is the reason it was put back onto the NPOESS mission.

Chairman LAMPSON. Will be on. Okay. Your report recommends doing so. It recommends flying a full OMPS sensor aboard the NPOESS satellite in 2013.

General Mashiko, we have been told that the program office will not accept any new instruments for that satellite. Is that true?

Brigadier General MASHIKO. The manifest for Charley 1 or the first flight version of NPOESS is locked down. Clearly, I understand how to take direction, but the reason why we locked down the configuration of the Charley 1 bird was to reduce the overall risk to that particular vehicle. If you take a look at the satellite that flies in the afternoon orbit versus the satellite that flies in the early morning orbit, that is the most complex. It actually has eight instruments on it, and as such it will be the most complex integration. And we are clearly biting off the most complex integration. In order to assure operational data continuity, which is my driving priority, I locked down that configuration. I briefed that, got EXCOM concurrence, and I also got the Milestone Decision Authority, the Under Secretary of Defense for Acquisition, Technology and Logistics, to concur with that recommendation of locking down that configuration as soon as possible so that we could keep the configuration of that particular satellite as simple as possible.

Chairman LAMPSON. The United States has obligations under the 1987 Montreal Protocol on ozone, and the OMPS–Limb helps us meet those obligations. We were assured that NPOESS was maintaining the ability to fly these orphan sensors if someone else built them and delivered them. The lead time for doing so seemed to be about two years before launch. We are six years away from NPOESS. Can we or can we not do this?

Dr. MARBURGER. There may be confusion about which flights the OMPS sensor is being restored to. My understanding is it would be restored to the NPOESS Preparatory Project satellite, the NPP, not the C1. It is a different satellite and which we do understand is locked down. I just wanted to make sure we are talking about the same satellite and that there is no conflict between my testimony and General Mashiko's.

Chairman LAMPSON. But is there not a desire to fly a full set of sensors on C1?

Dr. MARBURGER. The idea is to minimize data disruption and data gaps. We believe that it is appropriate to fly the OMPS–Limb sensor on the NPP satellite, which will be launched in 2009. My understanding is that that will address the problem that we foresaw with the data for that satellite and that the, that obviates the need to fly it on C1.

If I am mistaken in that, I will be glad to stand corrected, be corrected.

Chairman LAMPSON. The idea——

Dr. MARBURGER. But that is my understanding.

Chairman LAMPSON.—from my understanding was to fly another sensor on C1.

Did you want to make a comment, General Mashiko?

Brigadier General MASHIKO. Sir, I would like to make a comment. We do—will, in fact, have the OMPS–Nadir sensor on Charley 1, which will, in fact, provide the necessary data in order to meet the Kyoto protocols.

Chairman LAMPSON. If we want to put OMPS 1 back on, can we do it?

Brigadier General MASHIKO. Physically, it can be done, but it will be done at added risk to the on-time launch of the first operational NPOESS satellite, and it is a risk-benefit equation.

Chairman LAMPSON. And obviously more cost, more time.

Brigadier General MASHIKO. Yes, sir.

Chairman LAMPSON. The second priority listed in the January report is the Earth Radiation Budget Sensor for it measures how much of the sun's radiation gets absorbed by the land. Well, let me tell you. I am down to my time. Let me—I am going to stop and ask that question in a minute, because I would like to get the Ranking Member in with his first round of questions.

So, Mr. Inglis.

RISK OF COST OVERRUNS

Mr. INGLIS. Thank you, Mr. Chairman. Mr. Powner, you said that there is some concern about whether this can really be done for $12.5 billion. Will you elaborate on that? What are the risk factors there?

Mr. POWNER. A couple key risk factors. One would be the technical risks associated with key sensors, in particular VIIRS.

Mr. INGLIS. Uh-huh.

Mr. POWNER. That is one reason why we might see increased costs over time. We have a contract renegotiation coming up here in July. There is indications that costs could be higher based on that contract renegotiation, and we say that based on some preliminary estimates from the contractor that are higher than original estimates, which when you combine all that, that pushes you over the $12.5 billion threshold.

Mr. INGLIS. Dr. Marburger, General Mashiko, do you have any comment on that about those risks? What do you think about that, the chance of overruns from here?

Dr. MARBURGER. I am certainly not going to argue with GAO about risks of cost overruns. These are expensive, high-risk projects, and undoubtedly GAO's assessment needs to be attended to. Our concern here is that we move ahead with projects that are essential for the Nation's weather forecasting capabilities and for the science missions, whether they are performed using the NPOESS set of satellites or some other satellite approach.

Mr. INGLIS. Uh-huh. General Mashiko.

Brigadier General MASHIKO. Well, I do agree with the GAO with respect to the risks. There is something that should give yourself and the other Members of the Committee some feeling of confidence. There are some major cardinal changes that were, in fact, made to the program as part of the restructure, so there are fewer unknowns in the program—I guess—is the easiest way to look at it. Colonel Dan Stockton, who is the System Program Director, and his team laid out a program that took a six-month rolling wave—traditional way of operating a program, you only have detailed planning for six months—and laid out detailed planning from the start of the contract modification all the way to the conclusion of the contract. So they know in detail everything that needs to be done on the program between now and 2016. There is no task in that program plan that is longer than 66 days, and they know it with the assurity by having the right people laying out and reviewing those program plans.

So that should give the Committee some level of confidence that while there is still risk associated with the program, it is certainly better understood than it ever has been in the past.

AVOIDING COST OVERRUNS FOR FUTURE PROGRAMS

Mr. INGLIS. You know, I guess we could point out that it is not unusual for space acquisition programs to experience significant cost growth. You know, we have had the Space-Based Infrared Satellite and NASA's Webb telescope are a couple that were over. Is there something that is systematically wrong or any explanation, any thoughts about what the Government should be doing to control these costs, or is this just something you've got to expect with the first-of-a-kind kind of programs?

Brigadier General MASHIKO. They are looking my direction. It is not something that you should necessarily expect, but there are certain ground rules that need to be adhered to that we used to do in the old days of program management, and that is why we often refer to going back to basics. It is truly understanding where you stand with respect to technology maturation. You don't hold your design review too soon. When you put together your initial budgets for a program, you put together the initial budgets from the perspective of an independent cost estimate rather than a purely program office estimate or an agency estimate. You bring somebody else in to take a look at what you are doing and give you an independent assessment as to what you think it is going to cost.

And when you do the traditional things like that, the cost growths, while they still occur, tend to be smaller, and they are not quite as large, and you don't end up in a Nunn-McCurdy certification situation as this program did in late 2005.

Mr. INGLIS. All right. Mr. Powner.

Mr. POWNER. If I can just comment, in terms of NPOESS, what happened clearly with this, Ranking Member Inglis, is we greatly underestimated the complexity with NPOESS. We tried to address three agencies' requirements. That is a difficult thing to do. Clearly, a lot of the climate requirements have lost recently. We are trying to restore those, and you know, when you have three agencies involved, we try to put 13 sensors on a satellite, that is a lot. The complexity here was huge. I mean, one of the things we did with Nunn-McCurdy, the decision was to reduce the complexity, and you know, there are winners and losers here, and you know, with some of the losers we are trying to reinstate that now. But clearly underestimating the complexity and trying to do too much was a major misstep with this program.

Mr. INGLIS. Dr. Marburger, any thoughts about how we can improve on this?

Dr. MARBURGER. Well, clearly, many of the climate sensors that were de-manifested were added during the growth of the program, and one of the reasons that we have asked for additional information from NOAA and NASA about alternatives other than NPOESS—and not immediately rush to put these instruments back on NPOESS—is that we, too, are concerned about the complexity that they added to the project and the likelihood that putting them back would just cause more trouble. So we are looking at a wider range of possibilities than simply adding them back into NPOESS. That is why the analysis takes a certain amount of time.

Mr. INGLIS. Thank you, Mr. Chairman.

Chairman LAMPSON. I thank the Ranking Member.

We have been called for two votes. We don't know exactly how much time. It is probably about five or six minutes remaining for the first one. A second vote will come shortly thereafter. Probably be 15 to 20 minutes before we get back.

We will recess to go vote and ask your patience with us. Thank you, and we are in recess.

[Whereupon, at 1:42 p.m., the Subcommittee recessed, to reconvene at 2:12 p.m., the same day.]

Chairman LAMPSON. The Subcommittee on Energy and Environment is reconvened, and we left off in the middle of our first round of questions.

At this time I would recognize Ms. Biggert for five minutes.

DATA GAP CONCERNS

Ms. BIGGERT. Thank you, Mr. Chairman, and my first question is for Dr. Marburger.

I am concerned about the gaps in data that we are currently collecting, and this data provides us with a historical content that is very important as we try to understand the current changes in the weather and the climate. Does the refigured program lead to any gaps in the data?

Dr. MARBURGER. Well, the—as I understand it, the restructuring occurred—Nunn-McCurdy occurred with the data continuity as one of the high priorities for consideration. And that has also been the highest priority that we have had in mind in considering what to do with the sensor capabilities that were lost in the restructuring.

I think it is important to understand that while the sensors that are under discussion in this hearing are very important, they actually represent a small fraction of our climate science and ocean science research capabilities. There are many other ways of getting at some of these data. So we have to consider it in the context of the literally dozens of other Earth-observing satellites. There are approximately 25 satellites up there that are collecting Earth science data, nearly all of which are useful for climate science research and some for ocean research and some for solar research and for monitoring the space weather.

So I think perhaps our focus on the instruments on NPOESS has been somewhat misleading to the public who may not be aware of this vast array of other Earth-observing capabilities.

So it is primarily because of this complex context of capabilities that we have that we asked NOAA and NASA to perform these analyses that they gave to us in their white paper and are continuing to analyze because we do have other opportunities.

Ms. BIGGERT. Is it more important, then, to ensure that we get the sensors into space to avoid the gaps in the weather and climate data that is currently being collected or the sensors that collect new weather and climate data, since you say there are others. Shouldn't we wait until we find another way to test those new ones?

Dr. MARBURGER. Well, I think clearly we want to prioritize these and we want to make sure that the highest priority sensors for covering any potential data gaps are flying, either to be re-manifested on subsequent NPOESS missions, the ones that are not yet shut down, or on free-flying missions of their own. And we are committed to minimizing these data gaps to the extent possible, but it has to be done in the context of all of these other capabilities that we have.

But we undoubtedly will have to fly one of these sensors that has been de-manifested one way or another, and how we go about doing that is what is at issue here. We need to study that.

INTERAGENCY COLLABORATION: DRAWBACKS

Ms. BIGGERT. Then, Mr. Powner, when this project was originally started, it was a weather project, wasn't it? I mean, did we have the climate included in that?

Mr. POWNER. Well, weather was clearly the focus, but there was climatological information to be provided from NPOESS early on. Correct.

Ms. BIGGERT. Okay. Do you think that we might have proceeded at a faster pace if we had had just one agency that was in charge of this?

Mr. POWNER. Well, I think clearly if you look at the lessons learned on NPOESS, I mean, you can go back to where there was, you know, one of three, one of the agencies didn't fully fund it. It resulted in another agency decreasing funding. Yeah. Having a single agency program is far less complex, not only from some of the administrative and executive level management issues, but in terms of trying to meet everyone's requirements. That is very difficult. And then when you start prioritizing, as an example, you know, we had 55 environmental data records associated with NPOESS, and we asked time and time again what are the priorities, and we were always told 55, all 55 were needed. But after Nunn-McCurdy we go down to 39, and you even hear discussions now that there are some that are more important than others. So there still is a prioritization, but everyone wants everything when you have three agencies involved, and it makes it very complex.

Ms. BIGGERT. Well, doesn't every time they make a change or decide something, then three agencies having to go back and each of them to make a decision and then come back and see if they agreed. It seems that it is such a complex project that it would take awhile.

And would that increase the costs then, too? I mean, was that one of the things that made it so much more costly?

Mr. POWNER. Well, yeah. Clearly if you look over time with the increase in costs, this started as a $6 billion program, and you know, now we are at 12.5, so it is doubled, and that was a contributing factor.

Ms. BIGGERT. Thank you. I yield back.

Chairman LAMPSON. Thank you, Ms. Biggert.

Mr. Baird, if you are not ready to ask a question, then I will give myself five minutes.

MORE ON RESTORING ORPHAN SENSORS

Let me go back to what we had talked about toward the end of my questioning a while ago. OMPS has two pieces; Nadir and Limb. The Nadir piece is intended to go on NPOESS 1. My question was: if we wanted Limb to go back as well, and we would do, and as I understand General Mashiko's answer, we can, but it increases the risk, and that is correct.

Now, is that just the situation with the first satellite? If we ask to put Limb on the other satellites, would there be lower risks or higher risks in doing so?

Brigadier General MASHIKO. In a pure sense the risk equation—clearly any time you add something to a satellite, you have added risk—but what you have the virtue of in Charley 2, 3, 4, all the subsequent vehicles, you have already built one. You have already integrated the most complex, greatest number of sensors onto your satellite. So you know what you are adding to. So while it increases the risk, it is a smaller increase in risk when you add it to the subsequent units when you have already flight-demonstrated your first bird.

Chairman LAMPSON. Thank you very much.

The second priority listed in the January report is the Earth Radiation Budget Sensor for it measures how much of the sun's radiation gets absorbed by the land, by oceans, and by atmosphere. Continuity in measuring this is considered so important that the report wanted to take our last existing sensor and put it on Preparatory Project, put it on the Preparatory Project mission. Then build ERPS for the NPOESS satellites. Yet according to a presentation at last year's Polar Max conference, the team for this sensor is disbanded—"CERES team at NGST would have to be reconstituted."[10] The cost impact of canceling ERBS was $73 million. We are going to need this data I think, Dr. Marburger, if we are to understand climate change. NASA and NOAA recommend putting it on the first NPOESS satellite. What do we do?

Dr. MARBURGER. What do we do with that instrument is one of the questions that we have asked NASA and NOAA to give us more information on so that we can determine whether it makes sense to put it on one of the subsequent NPOESS satellites or on a free-flier of its own. Because there are options, obviously, to get this data from space missions other than NPOESS, and so the question is one of assessing the impact of possible schedules stretch—of increasing the risk of NPOESS versus the benefits associated with putting it on its own separate mission.

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[10] Stan Schneider, "Non-Manifested Sensors and Planning for Next Generation," Presentation at the 2006 Polar Max Conference. October 25, 2006; Silver Spring, Maryland. See slide 18. Accessed from *http://www.ipo.noaa.gov/polarmax/2006/day03/4.4schneiderPolar-Max SchneiderFinal.2006.ppt*

Those are the kinds of questions that take the experts to analyze and the context of all of our other Earth-observing missions and give us some advice, and we expect that decisions like that will be made in time to inform the budget process so that the President can ask Congress for the appropriate funds to resolve these questions.

Chairman LAMPSON. Why can we fly it on a free-flier if we took it off NPOESS because it cost too much? Cost differential? Same, more, less?

Dr. MARBURGER. We have already heard that the costs of NPOESS has escalated. It was multiplied by a factor of two since it originally was planned, and indeed, if additional cost increases, or worse, the loss of capability for weather prediction for the military is a consequence of putting it on, then we would certainly consider alternatives at—even at significant costs.

So the cost-benefit equation here has some pretty big numbers in it, and indeed it does make sense to consider free-flying missions for some of these other Earth-observing satellites.

I want to emphasize again the very large number of missions that we do fly for Earth observation. We have approximately 25 active Earth-observing satellite missions at the present time, and the NPOESS sensors represent a small portion of our capability for making these measurements. So the future of our Earth-observing program that supports climate and ocean science, it really needs to be considered in a much broader context than NPOESS.

Chairman LAMPSON. I understand that, but it just seems to me that making some of these decisions to, for example, stop work on one, cancel it, and then come back and put it, whether it is on a free-flier or back in the same place, adds so much more money. Why can't we make better decisions the first time around?

Dr. MARBURGER. Well, I think we have heard that question answered before. These are big, high-risk projects, and the management of them is very difficult, especially when more than one agency is involved. We are talking about big numbers, and we are talking about major costs associated with delays and lack of access to critical operational data. So in my view it is a part of the expense of doing business in this very high-tech, high-risk game that we are in.

Chairman LAMPSON. NPOESS has a history of taking really long to make those decisions, and, in my opinion, not following the plan that was put together in the first place, and perhaps if that plan had been followed on some more of these, perhaps there may have been some smaller amount of money spent. I will never, ever forget the project that was canceled at Johnson Space Center that costs, we made the decision to cancel that particular project, and it cost $12 million more to mothball it than it would have cost to complete it. And those are the kinds of decisions that I think we all ought to be ashamed of and make an attempt to do a much better job.

My time is up, and I now recognize Mr. Inglis for five minutes.

Mr. INGLIS. Thank you, Mr. Chairman.

MORE ON DATA GAPS

Dr. Marburger, if we could go to that redundancy question I think you were just answering from the Chairman and also earlier from Ms. Biggert. As soon as redundancy for weather observation and for climate change, are there other units up there that are gathering both types of information?

Dr. MARBURGER. Well, certainly weather information and climate information are coupled, and some instruments are dual-purpose as it were. In fact, even with the loss of the sensors in the restructured NPOESS program, there is still a significant climate change and ocean research-related capability on NPOESS. I would say about half of the climate-related science capability has been lost in the restructured programs.

But in addition to the NPOESS instruments, both those that are retained and restructured programs and those that were lost, there are literally dozens of other instruments that we have in space, and some on the ground, that are contributing data to the overall climate science effort. And that is what I was referring to, that we have a large number of satellites. We have the GOES[11] program, which is also weather, and it gives climate, but we have a number of other sensors on other satellite programs.

And this is part of an integrated Earth-observation system that the U.S. manages that a number of agencies participate in.

Mr. INGLIS. Sir, there is a recent article that said that, I quote, "Most of the climate instruments needed to collect more precise data over long periods of time are being eliminated." [12] Your response to that?

Dr. MARBURGER. I would say that that is a misleading statement. First of all, it is misleading if it is taken to, applied to all climate sensors that the U.S. has in space. That is totally incorrect. It is only a small fraction of the climate science sensors that we fly in our total climate science program.

With respect to the climate science capabilities of specifically the NPOESS program, it is probably half right, but I would say that, as I said in response to an earlier question, my impression is from the briefings that I have had and from the reports that I have read that about half of the climate science capability of NPOESS has been lost in the restructuring.

Mr. INGLIS. Yeah. The Director of Climate Science Watch said in that same article, was quoted in that same article as saying that, "We are going to start being blinded in our ability to observe the planet."

Dr. MARBURGER. That is a grossly misleading statement. We will by no means be blinded in our ability to observe the planet by the decisions that were made in the restructuring of the NPOESS program.

Mr. INGLIS. And that is because of all the other sensors.

Dr. MARBURGER. Right.

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[11] GOES: Geostationary Operational Environmental Satellite.

[12] John Heilprin, "U.S. Cuts Back Climate Checks From Space," The Associated Press, June 4, 2007; 6:59 P.M. EDT. Accessed at: *http://www.forbes.com/feeds/ap/2007/06/04/ap378087.html* (June 6, 2007).

Mr. INGLIS. Now, what if time goes on, and we don't meet the timelines from here for the launch of these, the new NPOESS satellites. Is there enough redundancy with the life expectancy of the existing satellites to continue to collect data?

Dr. MARBURGER. It would be, it would represent a serious problem for NOAA and the Department of Defense if the NPOESS mission were stretched out indefinitely. I mean, this is, in fact, a very important satellite program. It provides basic weather capabilities for operational weather forecasting for the National Weather Service and for the military. So it is important for NPOESS to survive, and that is one of the reasons that such drastic decisions were made to remove these important science sensors so that the remaining sensors could be launched on time.

And it is also one of the reasons that we are being so careful about making decisions to put things back, recommend to put things back on. You don't want to jeopardize those fundamental operational missions. We need to have the ability to track hurricanes and make weather forecasts for a variety of purposes.

So this is a program that got in trouble. It is very important. Priorities had to be set, reconfigurations had to be designed, and we are now facing the questions, the problem of what do we do next. How do we maintain as much capability as we can for these important missions and not lose the essential capabilities that NPOESS was designed for.

It doesn't mean that we are diminishing the science or that we don't think that the science is important. Indeed, we do, and we are committed to making our capabilities strong enough to continue to provide leadership in science, in climate science, as we have been.

Mr. INGLIS. Thank you, Mr. Chairman.

Chairman LAMPSON. Mr. Baird, you are recognized for five minutes.

IMPACT ON THE EARTH-OBSERVATION PROGRAM

Mr. BAIRD. Thank you, Mr. Chairman. I am interested in the interface between the manned missions and the Earth-observatory missions, and actually the President's call for eventually trying to get to Mars and how that may have impacted some of the Earth-observational missions in a variety of possible ways, which I will put out but then ask for your comment.

You could imagine it impacts it budgetarily, you could imagine that personnel are drawn from one mission to another, you can imagine that the perceived priority for advancement status of people working on one project versus another drops as some new, more glamorous or politically sexy thing comes in. What is—any insights into that, how this manned effort may have possibly adversely, or possibly complimentarily, impacted this; not just NPOESS but other Earth-observation missions?

Dr. MARBURGER. Well, there is no question that NASA operates in a pretty tight budget envelope, and in each request to Congress for funding for NASA the President, Office of Management and Budget, my office, and the agencies get together, we try to figure out what is going to work. And I must say that it would be easier to do the things that we ask NASA to do if Congress did, in fact, fund the requests that were made by, as a result of this planning project. It doesn't always happen, and it didn't happen this time.

For example, it would be a lot easier for the NASA Administrator to make these tough decisions if he had—if his budget were funded according to the plans that were developed during the budget process, which are embedded in the President's request to Congress. Congress did not fund NASA by half a billion dollars within the targets that the President had requested.

So things like that make it difficult. So we always have to go back and ask for impact statements and so forth to inform the next round of budgeting. But I believe that the American people support both space exploration and space science. They are exciting. The space science is just as exciting as the exploration. We have got these, it is not only photographs, but we have got really remarkable information about our universe that the American people and people around the world are excited about. So we are committed to both. This Administration has mapped out a space exploration vision that from the beginning was pitched as a step by step, not a——

Mr. BAIRD. I am going to interrupt you, Dr. Marburger. I hate to do that because——

Dr. MARBURGER. Sorry.

Mr. BAIRD.—I have a lot of respect for you, but if we recap the Administration's mission to Mars, we will not really get to the question I asked, and it would be delightful to do the other more fun, but the question I really asked was how does the very mission you are talking about impact the Earth-observational programs that we are, that are before us today.

Mr. Powner, would you care to comment on that or Dr. Marburger or General Mashiko?

Dr. MARBURGER. Let me add first of all, the NPOESS mission was funded through the Department of Defense and the Department of Commerce, not NASA. It certainly—NASA—some important space weather and Earth-observing missions are funded through NASA but——

Mr. BAIRD. Yeah. When I said NPOESS, I meant——

Dr. MARBURGER.—I believe——

Mr. BAIRD.—the broader Earth-observational plan.

Dr. MARBURGER. Yeah. I believe that this is not primarily a money problem. I believe the problem associated with NPOESS, the program we are talking about today, is not primarily a money problem. I believe it is a management problem.

Mr. BAIRD. Mr. Powner or General Mashiko, any comments on that?

Brigadier General MASHIKO. Certainly. To provide some insight at a purely tactical level, NASA has been very supportive of the program to the extent that while we have ten dedicated personnel, NASA-badged personnel working in my office or in Colonel Stockton's integrated program office, I have an additional 90 people that are supporting the program either full- or part-time out of NASA Goddard or out of Headquarters, and those people are provided based on being the subject-matter experts that we needed to work on either sensors or specific types of problems. And those were brought to bear by the chief engineer's office as well as the center director out at Goddard.

Mr. BAIRD. Was there any borrowing? In other words, were people moved from this mission or other related Earth-observational missions to focus on the manned exploration side at any point?

Brigadier General MASHIKO. Sir, these people—the areas of expertise were primarily in the types of sensors that are flying on the polar satellites as well as the GOES satellites. So it is that type of background that we are exploiting.

Mr. BAIRD. Mr. Powner, any comments?

Mr. POWNER. We clearly did not look in terms of, you know, where those folks came from to supplement Colonel Mashiko's staff.

Mr. BAIRD. I think whether or not the particular issue on this particular mission lead to a conclusion that the Moon/Mars exploration has impacted Earth observation in this particular case may be ambiguous. I don't think it is ambiguous. My read of the information is it is not ambiguous in a broader case of Earth observation. Would that be a fair statement? In other words, that there is fairly—there is a fairly clear potential adverse impact of the increased focus on the manned mission to the Moon and Mars, and we may choose to make that decision, but making that decision has impacts in a finite world with $2 billion a week going to Iraq, a $9 trillion budget deficit, a $450 billion operating deficit, et cetera, et cetera. Is that a fair statement that we are making a decision if we pursue these manned explorations to other planets to possibly give shorter shrift to our Earth observational?

Dr. MARBURGER. We always have to have priorities, and if there is limited funds, then you have to make priorities in each area, and everybody suffers. I believe that both sides of the NASA house, the exploration side and the science side, are operating under pretty severe budget constraints at the present time.

Mr. BAIRD. Thank you, Mr. Chairman.

Chairman LAMPSON. You are welcome, Mr. Baird.

I will now recognize Ms. Biggert for five minutes.

PROJECT MANAGEMENT

Ms. BIGGERT. Thank you, Mr. Chairman. Let me go back.

Dr. Marburger, you suggested that it was not a money problem but a management problem. Is that because of three agencies, or is there a different problem?

Dr. MARBURGER. I believe that the management issues have been outlined pretty well in the reports that you have available. The GAO has followed this for a long time, and you know, the management of big, technically-advanced programs is always difficult. It is hard to know where the technology will be by the time you are ready to launch or in the cases I am more familiar with, building particle accelerators. You really have to guess where the technology will be when you are ready to install it. And I think there is a special kind of management that goes with technically-intensive projects. This is the kind of management that General Mashiko is an expert in, and she referred to some of the things that one does in managing these types of programs.

So it isn't just a question of paying attention and keeping the books correctly. It is also a question of doing project management, to take into account the technical risks that you know are going to be there, and to have large contingencies and so forth that will prevent surprises.

Ms. BIGGERT. Well, as you know, as this progresses, do you think then that there should be just one agency involved? And if so, which one?

Dr. MARBURGER. Now we are getting into a matter of opinion here about the management. When it comes to space projects, there are two parts. One is the infrastructure associated with launching and operating in space, and there is quite a substantial infrastructure that is somewhat independent of the instruments. The other is the instrumental and scientific context. So very frequently you will have an agency like the National Science Foundation or the Department of Energy that has a project that needs to be launched in space. They almost have to work with NASA in order to couple the space expertise with the instrumental and science expertise.

So I believe that we will continue to see projects that are managed—that require multi-agency coordination, and we just have to learn lessons about how to do that from NPOESS and from the other projects, some of which have gone sour, too. We have to learn how to do that, because we are going to be doing more and more of it as time goes on.

INTERNATIONAL COLLABORATION

Ms. BIGGERT. How would you then characterize the international community's interest in remote sensoring, and should we be looking at opportunities to engage them with us and, again, this would be costs?

Dr. MARBURGER. We certainly should be, and one of the features of the restructured NPOESS program is to take advantage of European weather satellites in two of the orbits that were de-manifested. So prior to restructuring, there were six satellites in three different orbits associated with this program. After restructuring, there were four satellites in two orbits, and the third orbit would be provided by the Europeans, so that we are already taking into account the possibility that other countries will have capabilities that we can use. And we absolutely must be building those into our plans, those capabilities into our plans.

Ms. BIGGERT. Thank you. I yield back.

Chairman LAMPSON. Thank you, Ms. Biggert.

Mr. Diaz-Balart, five minutes.

QUIKSCAT

Mr. DIAZ-BALART. Thank you very much, Mr. Chairman. I want to talk a little bit about the QuikSCAT satellite. I was in the Hurricane Center just last week for obvious reasons, and I was able to see firsthand—and which I had seen before, the actual passes of the QuikSCAT satellite that provides some information that frankly, is extremely valuable to, you know, to figure out where the centers of the storms are, et cetera. And we all know that it was supposed to have a five-year lifespan. It is on its eighth year. It may be on its way out. We don't know. And what was supposed to replace that was taken out of the ones that are supposed to come up shortly, and now the replacement doesn't go up to 2016.

Frankly, that is a little worrisome. Yes, they are looking at ways to tap into other satellites, European satellites, but what I have heard is that what that satellite provides is frankly something that is not totally replaceable with what is out there right now.

And the question is why 2016, if we know that we have a satellite that is, you know, on its eighth year of what is supposed to be a five-year lifespan. And after knowing that, you know, we are in an elevated cycle of storms that about a 30-year cycle history will show us, and we know the cost of those storms, I don't quite understand why that is not a higher priority.

Dr. MARBURGER. Mr. Congressman, the QuikSCAT information is clearly important for tracking hurricanes. We understand the importance of that program and are watching it.

The problems that have been publicized associated with QuikSCAT have not appeared in any priority documentation that has reached me or my office. My understanding is that the satellite continues to be very functional, all of its instruments are functioning, it has switched over to a back-up telemetry system, which is functioning very well. I presume it is at least as robust as the original telemetry system with which there was a problem, but it is not, it has not been rated as requiring urgent attention at this time. And as soon as an agency that has responsibility for this, these types of measurements notifies us that it is an urgent priority, we will certainly pay attention to it. But it simply hasn't risen to that level of priority that we have seen fit to intervene on.

Mr. DIAZ-BALART. If I may, Mr. Chairman.

Chairman LAMPSON. Yes.

Mr. DIAZ-BALART. Mr. Chairman, if I may, I bring this up because obviously if we were to lose that satellite, that capability, it is about a 16 percent reduction in the actual forecasting, you know, coverage.

Chairman LAMPSON. Right.

Mr. DIAZ-BALART. Or efficiency or whatever you want to call it.

Chairman LAMPSON. An important piece. Right.

Mr. DIAZ-BALART. Right. Right. Now, if you would be so kind, sir, if you would have somebody look into that, because I do know, I'm not the smartest guy in the world, but it seems to me that if it is a five-year lifespan, and you are on the eighth year, and now we are looking at until 2016, I don't know how many years you can milk out of something like this. But I would like somebody to get back to me and tell me they have looked at that. If, in fact, there is absolute confidence that it is going to be there, working well until then, and if not, what are the alternatives. Because I just, I am a little concerned as you can well know, you can imagine, the hurricane season comes, and I represent South Florida and the only hurricanes we like are the football team from the University of Miami.

Dr. MARBURGER. Well, despite the fact that this hasn't come up in our discussions and briefings, when we heard about the concerns we began to look at them. We will get back to you.

Mr. DIAZ-BALART. Great.

Dr. MARBURGER.With whatever we find.

Mr. DIAZ-BALART. Great. Thank you, sir. Thank you, Mr. Chairman.

Chairman LAMPSON. Thank you, Mr. Diaz-Balart.

I yield myself five minutes.

GENERAL MASHIKO'S DEPARTURE

Dr. Marburger, your testimony about management just a minute ago obviously referred to also what General Mashiko said earlier about it is hard to find talented space people. But is that not exactly the reason why she ought to be considered to be kept as the director, or as the person over this program, rather than changing horses at this time?

Dr. MARBURGER. That is not my decision to make. That is the Department of Defense's decision. They have the responsibility for managing this program, and they are one of the principle beneficiaries of the results from NPOESS, and I believe that——

Chairman LAMPSON. Would you agree with me that is something that they certainly ought to consider?

Dr. MARBURGER. I have the highest respect for General Mashiko's talents, and I wish she were working for me.

Chairman LAMPSON. All right. Mr. Powner, would you comment, and so would you, General Mashiko, would you, I don't want to put you on the spot, both of you. Start with Mr. Powner.

Mr. POWNER. Well, clearly that was one of the recommendations in our report. You are at a point in this program where there is still a lot of risks involved, VIIRS in particular. They need to be aggressively managed. She does a very good job holding contractors accountable, picking up the phone, talking to executives, with the various contractors and subcontractors, getting them to the table. We don't believe now is the time to rotate someone like General Mashiko. She does a very good job, and an important part of this program is continuity of executive leadership. That has been a problem leading up to the Nunn-McCurdy issue, and now you have a key executive, and you are about to rotate her off. We don't think that is wise.

Chairman LAMPSON. Thank you. Now I will put you on the spot.

Brigadier General MASHIKO. Let me address it a couple ways, sir. The upcoming period—because we are going to have the program restructured and in place in the beginning of July, is going to be primarily execution. Now that there is a—there will be a contract in place, so it is going to be primarily execution; where you are going to need the critical continuity is, in fact, at the program director level. The way you separate the area of responsibility, if you will, the program director is the one that truly makes the contactor execute on a day-to-day fashion. The program executive deals up and out, and with respect to my job, which is up and out, clearly sitting here and dealing with various other agencies, the Department of Commerce has the responsibility to replace me. They have been using the standard OPM process in order to do that. They got a reasonable number of candidates. They were screened. The candidates have, in fact, been interviewed, and as soon as we get the EXCOM, all three members on the telephone to do the actual ratification of the selection, the name will go forward to OPM for approval.

And I have been informed that we do have a viable candidate for my replacement, and so once that happens we will be more than happy to let the Committee know who that is, in fact, going to be.

Chairman LAMPSON. Thank you very much.

PROGRAM STATUS

Is the NPOESS program as currently constituted on track to deliver four satellites in orbit to operate between the years 2013 and 2036—2026, excuse me—for an acquisition cost of $11.5 billion, and an additional $1 billion in operating costs?

Brigadier General MASHIKO. Sir, until the contract is negotiated, all I can tell you is that is what the plans are. At the present time we believe that the program will, in fact, meet the total acquisition cost of $11.5 billion with the additional billion dollars for operations and support.

To give you additional confidence and to give myself additional confidence, I asked the OSD[13] cost group who did the original independent cost estimate that the Nunn-McCurdy was based on, I asked them to do an independent cost estimate as to what operations and support will be in the future, and the allocation of those dollars and which year should they be so that we can do the necessary flow of money to get everything correctly lined up.

So that is in work. That, in parallel with the negotiation of the actual modification, will solidify what the final cost of the program should be, and then we can then make any adjustments to the budget. But any adjustments to the budget will be in the out years, not the years of execution.

Chairman LAMPSON. Okay. You believe right now it is on track?

Brigadier General MASHIKO. Yes, sir.

Chairman LAMPSON. I hesitate to ask this. My time is——

Mr. POWNER. Mr. Chairman, can I just add something to that?

Chairman LAMPSON. Please.

Mr. POWNER. You know, that is fine that we are making that statement, but I just want to be clear that GAO's opinion on this, there are still a lot of risks, and until that contract's inked, you know, I think we need to remain very cautious with that estimate until that contract is solidified. And that is to be next month.

Chairman LAMPSON. Thank you. I know my time is up. Bear with me for just a second, please, because this is a short question, and maybe rhetorical.

The report from NASA and NOAA did not include financial data that was necessary—that deal with a lot of this. Along the way has anyone been fired or censored because of actions that they have taken, or has any contract been terminated? Anybody, please.

Brigadier General MASHIKO. Sir, let me ask you what timeframe do you mean, and then I will——

Chairman LAMPSON. At any time.

Brigadier General MASHIKO. Okay. Let me back all the way up to August of 2005. At that point the system program director resigned. That was the government system program director. At the contractor, the contractor program director was removed. Most of his management staff was, in fact, changed at the contractor at the

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[13] OSD: Office of the Secretary of Defense.

Northrop Grumman level. If you go to Raytheon, Santa Barbara, which was responsible for the VIIRS contract, we have done, over time, almost two full management shifts and change-outs in order to find the right management team to actually execute the program. As a result we have a vice-president out at Raytheon literally running the VIIRS program. He is a Navy nuke guy, so he comes from a zero-defect kind of background, and that is the type of management rigor that has been put in place out at Santa Barbara. The management team at Northrop Grumman—what we have done there, in addition to doing the change of the program manager—originally that program manager was a direct report to the sector president, totally bypassing the functionals, if you will, within the Northrop Grumman campus. We have changed that such that NPOESS is not treated as a normal program, and the functional vice presidents at Northrop Grumman are now fully engaged in the program, bringing that level of expertise and experience to the program as well.

Chairman LAMPSON. Thank you very much. Were you responsible for most of that?

Brigadier General MASHIKO. Sir, myself and my team.

Chairman LAMPSON. I hate to see you go. Thank you for your good service.

I yield five minutes to Mr. Inglis, the Ranking Member.

MORE ON GENERAL MASHIKO'S DEPARTURE

Mr. INGLIS. General Mashiko, based on your departure coming up in a month, I think it is, is there going to be enough time for you to bring the replacement up to speed, or is that a concern that you have?

Brigadier General MASHIKO. Sir, in all honesty it is going to depend on who the individual actually selected is. And we will make the necessary adjustments. The Air Force is prepared to allow me to split my time in order to do a correct transition if it is somebody who is being brought in from the outside.

Mr. INGLIS. Right. Because it does sound like, particularly based on your last entry, the last question, that there is an awful lot of information that you will be taking with you that needs to be imparted to your replacement. So I hope there is some flexibility on how it is that you will be able to bring them up to speed.

Brigadier General MASHIKO. Yes, sir. There is a great deal of flexibility with my new boss, and the other thing is, is the new job that I am going to I will be spending considerable time in the Washington, D.C. area, so that will also facilitate any additional overlap that is required after my departure.

Mr. INGLIS. Nice to be so indispensable, isn't it? That is a good thing, you know.

Brigadier General MASHIKO. Yes, sir. Job security is a wonderful thing.

Mr. INGLIS. I have no further questions, Mr. Chairman.

Chairman LAMPSON. Mr. Baird. Five minutes.

TECHNOLOGY TRANSFER

Mr. BAIRD. The gentleman from Florida raised an interesting issue that highlights a broader question which has to do with the research operations process. So you set up, buy something for research purposes, you come back with some interesting data. How then do you translate that instrumentation or the analogs that develop out of that or whatever data you get into actual usage, sustainable information feedback? And this research to operations gap. Could anybody comment on that and what is being done to address that? So we don't just go out, find something interesting, and then not actually apply it down the road. And sometimes you find something that is not applicable, but if you find something useful, what are we doing to follow up on that?

Dr. MARBURGER. On the science side most of the data analyses that lead to discoveries are published in the open literature, and that is the medium of communication at the basic level that the science community relies on to get these ideas out and have them discussed in conferences. And there are usually teams of people sometimes from multiple federal laboratories and universities that manage these so that they appear at conferences.

Mr. BAIRD. I have read many of the special issues of *Science* from these very things.

Dr. MARBURGER. You know how that works.

Mr. BAIRD. I am a long member of AAAS[15] and subscribed——

Dr. MARBURGER. So the next steps are usually rather complicated and not terribly well defined. Most institutions, both federal labs and universities have technology transfer offices that are alert for ideas that their scientists have that might be turned into commercially-significant applications, and they work with the faculty and or with the scientists who protect the intellectual property.

Mr. BAIRD. Now, what about NASA and NOAA, that interface? You know, you send up a research flight, find something interesting. Do you then incorporate that in terms of a long-term observational system or something stable that becomes part of your regular routine?

Dr. MARBURGER. When it comes to the instrumentation, absolutely. The discoveries that are made, for example, by a contractor developing an advanced sensor are typically made available to other projects. And I would say that some of the technology that we find on our cell phones and our digital cameras came from early work and early experience with NASA imaging requirements. And particularly from military imagining requirements. So we have——

Mr. BAIRD. I appreciate, I know there are spin offs in the general. I am told that this is a recurring problem or perceives to be a recurring problem, that we sort of do one slight thing but they don't necessarily translate into long term in the NASA–NOAA interface.

Dr. MARBURGER. Well, I don't think the NASA–NOAA interface is unique. I believe that this problem exists with almost every scientific application, but the, you know, what makes the communications work is that the scientists and the engineers talk to each other about whether there are stovepipes in agencies or not. The good ideas do tend to get translated.

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[15] AAAS: American Association for the Advancement of Science.

So my view is it is a complex press. There may be cases where interagency communications aren't ideal, but in this scientific community and the technical community, there is a great deal of interchange of ideas.

I would be glad to respond to it to more specific or detailed questions about this because it is an important issue that my office watches. And we specifically are charged by Congress to do interagency coordination and sometimes it is not easy. So if problems arise that you are aware of that you would like to have more feedback on or just——

Mr. BAIRD. I guess one example I could imagine, you know, you build these things and so it is an interactive process. So you send up a flight, gather some data. For sure then somebody else wants to send their flight up, and they want to gather their data.

Dr. MARBURGER. Right.

Mr. BAIRD. But the question for me is to what extent do you—is there a prioritization that says, "Okay, we sent this up. We learned this from this." Now, maybe our next test flight is not—whoever happens to be next in the queue of putting something from the first one we learned permanently because, lo and behold, it was actually useful instead of having—okay. Shelve that. Publish your special issue of *Science* magazine. We all read it, and—or most people don't, but then we go to the next, publish a special issue of *Science,* and somewhere along the line that cumulative benefit gets lost.

Dr. MARBURGER. In general that kind of intelligence that is brought to the sequence of scientific explorations is provided by the scientific community through the National Academies of Science, and the decadal surveys and the special reports that are commissioned both by NOAA and by NASA are taken very seriously by those agencies as they plan their projects and programs. And we watch that process at OSTP. We force the agencies to come together and make strategic plans together that provide guidance for all the agencies that might participate in these. And we frequently ask the agencies to go to the National Academy or to their own external advisory panels of scientists to get advice on what to do next and how to take advantage of that data that already exists.

Mr. BAIRD. Anyone else care to comment on that?

Thank you, Mr. Chair.

Chairman LAMPSON. Thank you, Mr. Baird.

MORE ON DATA GAP CONCERNS

General Mashiko, GAO states that the cost analysts are about 90 percent confident that there will be—that they are 90 percent confident that there will be no weather coverage gap. What is the basis for that confidence?

Brigadier General MASHIKO. Sir, when we went through the Nunn-McCurdy process, that was the driving priority, and it was the operational data continuity. What we did was in order to assure approximately a 90 percent operational data continuity, which the GAO refers to, we had to pull risks out of the first NPOESS bird in order to increase the likelihood of it being able to be launched on the date specified, which is why the CMIS[16] sensor was canceled and taken off of the first Charley bird and put on the second Charley bird. Because that was going to be the critical path for that, the first operational NPOESS, and we needed to get the risk equation down such that we increased the likelihood that that satellite would, in fact, be able to be delivered and launched when it was going to be needed in the afternoon orbit. Because if you take a look at the heritage satellites, which are DMSP[17] in the early morning and mid-morning in orbit and then POES[18] in the afternoon orbit, they actually run out of POES in the afternoon orbit, and there would be an operational data gap such that we wouldn't be able to do standard weather forecasting that we have all gotten used to on the Weather Channel, unless we were able to get the NPOESS bird up there in the timeframe.

And that is what is generally referred to as the 90 percent schedule.

Chairman LAMPSON. Mr. Powner, could you comment also?

Mr. POWNER. Well, I think what this, what came out of Nunn-McCurdy really highlights the importance of staying on schedule now. I mean, we have pushed a lot of these birds, extending their useful lives. I mean, fortunately, we have been able to push off some of the launches of POES and DMSP, but it is important from this point forward that we really do stick to the schedule going forward so that we may maintain that continuity.

And I think the General brings up a very important balancing act here in terms of, you know, what we add to C1 and when we lock that down to keep it simple so that we can hit that date.

Chairman LAMPSON. Okay. The GAO also paraphrases the cost analyst as saying that they are highly confident acquisition costs will not exceed $11.5 billion, but a lower level of confidence that the sensor configuration will remain unchanged. The lower level of configuration and the sensor configuration suggests to me that the program is prepared to accept further changes that will decrease the observational capabilities of this satellite system to maintain this budget. Is that the case, first, General Mashiko? And then Mr. Powner, would you comment?

Brigadier General MASHIKO. Sir, I believe what the cost analysts are referring to—to put it very simply, normally I always have a program schedule where I have a triangle on it that I don't generally publish, and that is the day I shoot the engineers, because literally you need to stop doing the changes, you button up what you have got, and you go with it. Because you are better off getting what you have on orbit and getting the utility of out it and then making step wise changes or improvements on the next serial number.

And that is I believe what the cost analysts were referring to. It is not a matter of taking sensors off. It is being able to make the decision of go with what you have got, get it on orbit, and get the end-to-end data chain up and operational. And then make step-wise improvements if necessary to subsequent serial numbers.

Chairman LAMPSON. Mr. Powner.

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[16] CMIS: Conical Microwave Imaging Sounder.

[17] DMSP: Defense Meteorological Satellite Program.

[18] POES: Polar-orbiting Operational Environmental Satellite.

Mr. POWNER. That is a fine approach to mitigate risks. I think the key question, though, going forward, and one example is NPP with the preparatory satellites that is currently in place. You know, it will fly. The game plan now is to fly it on schedule, but it is going to fly in a degraded mode where there are certain environmental data records that will not be available.

In particular, the way we measure ocean color and aerosol measurement, and what does that mean to users so we can button down and hit schedule and that type of thing, but there is an impact on users, and that needs to be clearly articulated.

Chairman LAMPSON. Well, thank you. Thank all of you very, very much. We appreciate your being here and for your testimony before the Committee today and at other times.

The record will remain open for additional statements from the Members and for answers to any follow-up questions the Committee may ask of the witnesses.

The witnesses are excused, and the hearing is now adjourned. Thank you all.

[Whereupon, at 3:05 p.m., the Subcommittee was adjourned.]

Appendix:

ADDITIONAL MATERIAL FOR THE RECORD

United States Government Accountability Office

GAO

Report to Congressional Requesters

April 2007

POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES

Restructuring Is Under Way, but Technical Challenges and Risks Remain

This Report Is Temporarily Restricted Pending Official Public Release.

GAO

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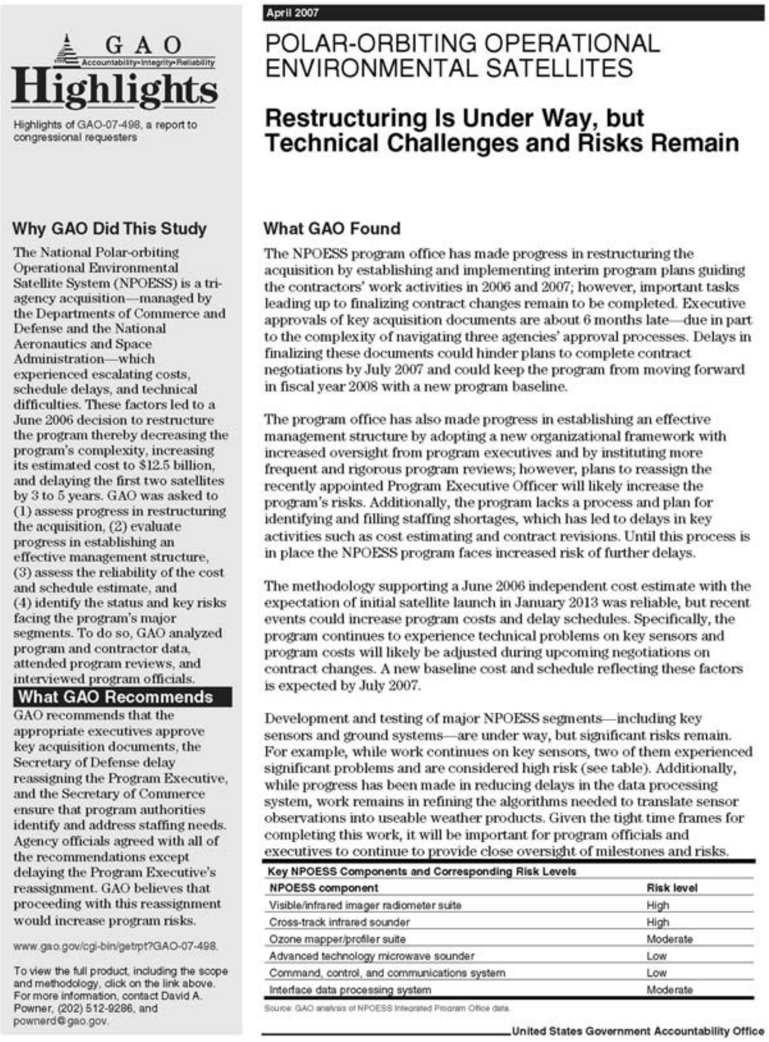
GAO-07-498



Highlights

Highlights of GAO-07-498, a report to congressional requesters

April 2007

POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES

Restructuring Is Under Way, but Technical Challenges and Risks Remain

Why GAO Did This Study

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) is a tri-agency acquisition—managed by the Departments of Commerce and Defense and the National Aeronautics and Space Administration—which experienced escalating costs, schedule delays, and technical difficulties. These factors led to a June 2006 decision to restructure the program thereby decreasing the program's complexity, increasing its estimated cost to $12.5 billion, and delaying the first two satellites by 3 to 5 years. GAO was asked to (1) assess progress in restructuring the acquisition, (2) evaluate progress in establishing an effective management structure, (3) assess the reliability of the cost and schedule estimate, and (4) identify the status and key risks facing the program's major segments. To do so, GAO analyzed program and contractor data, attended program reviews, and interviewed program officials.

What GAO Recommends

GAO recommends that the appropriate executives approve key acquisition documents, the Secretary of Defense delay reassigning the Program Executive, and the Secretary of Commerce ensure that program authorities identify and address staffing needs. Agency officials agreed with all of the recommendations except delaying the Program Executive's reassignment. GAO believes that proceeding with this reassignment would increase program risks.

www.gao.gov/cgi-bin/getrpt?GAO-07-498.

To view the full product, including the scope and methodology, click on the link above. For more information, contact David A. Powner, (202) 512-9286, and pownerd@gao.gov.

What GAO Found

The NPOESS program office has made progress in restructuring the acquisition by establishing and implementing interim program plans guiding the contractors' work activities in 2006 and 2007; however, important tasks leading up to finalizing contract changes remain to be completed. Executive approvals of key acquisition documents are about 6 months late—due in part to the complexity of navigating three agencies' approval processes. Delays in finalizing these documents could hinder plans to complete contract negotiations by July 2007 and could keep the program from moving forward in fiscal year 2008 with a new program baseline.

The program office has also made progress in establishing an effective management structure by adopting a new organizational framework with increased oversight from program executives and by instituting more frequent and rigorous program reviews; however, plans to reassign the recently appointed Program Executive Officer will likely increase the program's risks. Additionally, the program lacks a process and plan for identifying and filling staffing shortages, which has led to delays in key activities such as cost estimating and contract revisions. Until this process is in place the NPOESS program faces increased risk of further delays.

The methodology supporting a June 2006 independent cost estimate with the expectation of initial satellite launch in January 2013 was reliable, but recent events could increase program costs and delay schedules. Specifically, the program continues to experience technical problems on key sensors and program costs will likely be adjusted during upcoming negotiations on contract changes. A new baseline cost and schedule reflecting these factors is expected by July 2007.

Development and testing of major NPOESS segments—including key sensors and ground systems—are under way, but significant risks remain. For example, while work continues on key sensors, two of them experienced significant problems and are considered high risk (see table). Additionally, while progress has been made in reducing delays in the data processing system, work remains in refining the algorithms needed to translate sensor observations into useable weather products. Given the tight time frames for completing this work, it will be important for program officials and executives to continue to provide close oversight of milestones and risks.

Key NPOESS Components and Corresponding Risk Levels

NPOESS component	Risk level
Visible/infrared imager radiometer suite	High
Cross-track infrared sounder	High
Ozone mapper/profiler suite	Moderate
Advanced technology microwave sounder	Low
Command, control, and communications system	Low
Interface data processing system	Moderate

Source: GAO analysis of NPOESS Integrated Program Office data.

United States Government Accountability Office

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Abbreviations

ATMS	advanced technology microwave sounder
CMIS	conical-scanned microwave imager/sounder
CrIS	cross-track infrared sounder
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
EDR	environmental data record
IDPS	interface data processing system
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite Data and Information Service
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
POES	Polar-orbiting Operational Environmental Satellites
OMPS	ozone mapper/profiler suite
VIIRS	visible/infrared imager radiometer suite

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GAO
Accountability * Integrity * Reliability
United States Government Accountability Office
Washington, DC 20548

April 27, 2007

The Honorable Nick Lampson
Chairman
The Honorable Bob Inglis
Ranking Republican Member
Subcommittee on Energy and Environment
Committee on Science and Technology
House of Representatives

The Honorable David Wu
House of Representatives

The Honorable Vernon J. Ehlers
House of Representatives

The planned National Polar-orbiting Operational Environmental Satellite System (NPOESS) program is expected to be a state-of-the-art, environment-monitoring satellite system that will replace two existing polar-orbiting environmental satellite systems. Polar-orbiting satellites provide data and imagery that are used by weather forecasters, climatologists, and the military to map and monitor changes in weather, climate, the oceans, and the environment. The NPOESS program is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting (including severe weather events such as hurricanes) and global climate monitoring through the year 2026.

Three agencies share responsibility for the NPOESS acquisition: the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD)/United States Air Force, and the National Aeronautics and Space Administration (NASA). To manage the NPOESS program, these agencies established a tri-agency integrated program office. In recent years, this program has experienced escalating costs, schedule delays, and technical difficulties, leading to a June 2006 decision to restructure the program. This decision decreased the complexity of the program by reducing the number of satellites and sensors, increased the estimated cost of the program to $12.5 billion, and delayed the launches of the first two satellites by 3 to 5 years.

This report responds to your request that we (1) evaluate the NPOESS program office's progress in restructuring the acquisition, (2) evaluate the program office's progress in establishing an effective management structure, (3) assess the reliability of the life cycle cost estimate and proposed schedule, and (4) identify the status and key risks facing the program's major segments and evaluate the adequacy of the program's efforts to mitigate these risks.

To evaluate the program office's progress in restructuring the acquisition, we assessed program documentation, attended management status briefings, and interviewed program officials. To determine progress in establishing a new management structure, we assessed the status of efforts to implement past recommendations regarding the management structure and staffing, attended senior-level management review meetings, reviewed program documents, and interviewed program officials. To assess the cost estimate, we evaluated the methodology and assumptions used to develop the estimate and interviewed program officials to identify any assumptions that may have changed. To determine the status, risk, and risk mitigation efforts for the program, we analyzed monthly program management documents and interviewed NOAA, NASA, and DOD officials to determine concerns with these mitigation efforts. In addition, this report builds on other work we have done on environmental satellite programs over the last several years.[1]

We conducted our work at the NPOESS Integrated Program Office headquarters and at DOD, NOAA, and NASA facilities in the Washington, D.C., metropolitan area. We performed our work from July 2006 to April 2007 in accordance with generally accepted government auditing standards. Appendix I contains additional details on our objectives, scope, and methodology.

Results in Brief

The NPOESS program office has made progress in restructuring the acquisition by establishing and implementing interim program plans guiding the contractors' work activities in 2006 and 2007; however, important tasks leading up to finalizing contract changes remain to be completed. While the program office developed key acquisition documents, including a memorandum of agreement on the roles and responsibilities of the three agencies, a revised acquisition strategy, and a system engineering plan, the responsible executives in the three agencies have not yet approved these documents—even though they were due by September 1, 2006. Finalizing these documents is essential to ensure interagency agreement and will allow the program office to move forward in completing other activities related to restructuring the program. These activities include conducting an integrated baseline review with the contractor to reach agreement on the schedule and work activities and finalizing changes to the NPOESS development and production contract—thereby allowing the program office to lock down a new acquisition baseline cost and schedule. Until the key acquisition documents are approved by the appropriate executives in each agency, the program faces increased risk that restructuring activities will not be completed in time to allow it to move forward in fiscal year 2008 with a new program baseline in place. This places the NPOESS program at risk of continued delays and future cost increases.

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[1] GAO, *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold*, GAO-06-573T (Washington, D.C.: Mar. 30, 2006); GAO, *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions*, GAO-06-249T (Washington, D.C.: Nov. 16, 2005); GAO, *Polar-orbiting Environmental Satellites: Information on Program Cost and Schedule Changes*, GAO-04-1054 (Washington, D.C.: Sept. 30, 2004); GAO, *Polar-orbiting Environmental Satellites: Project Risks Could Affect Weather Data Needed by Civilian and Military Users*, GAO-03-987T (Washington, D.C.: July 15, 2003); and GAO, *Polar-orbiting Environmental Satellites: Status, Plans, and Future Data Management Challenges*, GAO-02-684T (Washington, D.C.: July 24, 2002).

The program office has also made progress in establishing an effective management structure by adopting a new organizational framework with increased oversight from program executives and by instituting more frequent and rigorous program management reviews; however, planned changes in executive management will likely increase program risk, and the program lacks a process and plan for identifying and filling staffing shortages. As a result, the program experienced delays in beginning key activities such as cost estimating and contract revisions. Until this process is in place and working, the NPOESS program faces increased risk of further delays.

The methodology supporting a June 2006 cost and schedule estimate was reliable, but recent events could lead to increased program costs and delay schedules. DOD's independent cost estimating group used an acceptable methodology in developing a June 2006 cost estimate of $11.5 billion for the acquisition portion of the restructured program with the expectation of initial satellite launch in January 2013. Consistent with DOD direction, this estimate did not include roughly $1 billion in operations and support costs—bringing the total life cycle cost estimate to $12.5 billion. However, the program continues to experience technical problems on key sensors, and program costs will likely be adjusted during upcoming negotiations on contract changes. The NPOESS program office is developing its own cost estimate to further refine the one developed in June 2006 to help it negotiate contract changes. A new baseline cost and schedule will be established once the contract is finalized—an event that the Program Director expects to occur by July 2007.

Development and testing of major program segments—including key sensors and the ground systems—are under way, but significant risks remain. For example, work continues on key sensors, but two sensors—the Visible/Infrared Imager Radiometer Suite and the Cross-track Infrared Sounder—continue to experience significant difficulties. Specifically, the former encountered three significant problems with image quality and reliability during environmental testing of the engineering unit, and the latter suffered a major structural failure during vibration testing. Additionally, while significant progress has been made in reducing delays in the NPOESS data processing system, much work remains in refining the algorithms needed to translate sensor observations into usable weather products. Given the tight time frames for completing key sensors, integrating them with the demonstration spacecraft (called the NPOESS Preparatory Project or NPP) and getting the ground-based data processing systems developed, tested, and deployed, it will be important for the Integrated Program Office, the Program Executive Office, and the Executive Committee to continue to provide close oversight of milestones and risks.

We are making recommendations to the Secretaries of Commerce and Defense and to the Administrator of NASA to ensure that the appropriate executives finalize key acquisition documents by the end of April 2007 in order to allow the restructuring of the program to proceed. We are also making recommendations to the Secretary of Defense to direct the Air Force to delay reassigning the recently appointed Program Executive Officer until key program risks are resolved. We are also making recommendations to the Secretary of Commerce to ensure that NPOESS program authorities develop and implement a written process for identifying and addressing human capital needs and that they establish a plan to immediately fill needed positions.

The Department of Commerce, DOD, and NASA provided written comments on our draft report (see apps. III, IV, and V). All three agencies agreed that it was important to finalize key acquisition documents in a timely manner, and DOD proposed extending the due dates for the documents to July 2, 2007. In addition, the Department of Commerce concurred with our recommendation to identify and address human capital needs and immediately fill open positions in the NPOESS program office. Commerce noted that NOAA was taking actions in both areas. However, DOD did not concur with our recommendation to delay reassigning the Program Executive Officer, noting that the Program Director responsible for the acquisition program would remain in place for 4 years. While it is important that the System Program Director remain in place to ensure continuity in executing the acquisition, this position does not ensure continuity in the important oversight and coordination functions provided by the current Program Executive Officer. We remain concerned that reassigning the Program Executive at a time when NPOESS is still facing critical cost, schedule, and technical challenges will place the program at further risk.

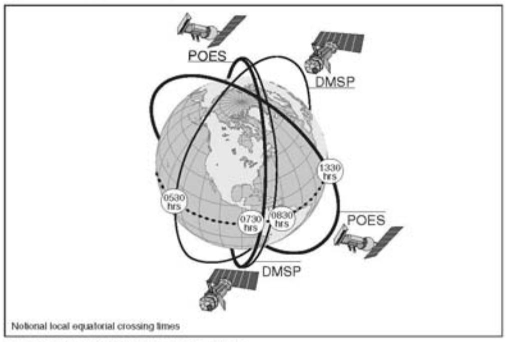
All three agencies also provided technical comments, which we have incorporated in this report as appropriate.

Background

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series—managed by NOAA, and the Defense Meteorological Satellite Program (DMSP)—managed by the Air Force. These satellites obtain environmental data that are processed to provide graphical weather images and specialized weather products. These satellite data are also the predominant input to numerical weather prediction models, which are a primary tool for forecasting weather 3 or more days in advance—including forecasting the path and intensity of hurricanes. The weather products and models are used to predict the potential impact of severe weather so that communities and emergency managers can help prevent and mitigate their effects. Polar satellites also provide data used to monitor environmental phenomena, such as ozone depletion and drought conditions, as well as data sets that are used by researchers for a variety of studies such as climate monitoring.

Unlike geostationary satellites, which maintain a fixed position relative to the earth, polar-orbiting satellites constantly circle the earth in an almost north-south orbit, providing global coverage of conditions that affect the weather and climate. Each satellite makes about 14 orbits a day. As the earth rotates beneath it, each satellite views the entire earth's surface twice a day. Currently, there are two operational POES satellites and two operational DMSP satellites that are positioned so that they can observe the earth in early morning, midmorning, and early afternoon polar orbits. Together, they ensure that, for any region of the earth, the data provided to users are generally no more than 6 hours old. Figure 1 illustrates the current operational polar satellite configuration. Besides the four operational satellites, six older satellites are in orbit that still collect some data and are available to provide limited backup to the operational satellites should they degrade or fail. In the future, both NOAA and the Air Force plan to continue to launch additional POES and DMSP satellites every few years, with final launches scheduled for 2009 and 2012, respectively.[3]

Figure 1: Configuration of Operational Polar Satellites



Notional local equatorial crossing times

Source: GAO, based on NPOESS Integrated Program Office data.

Each of the polar satellites carries a suite of sensors designed to detect environmental data that are either reflected or emitted from the earth, the atmosphere, and space. The satellites broadcast a subset of these data in real time to properly equipped field terminals that are within a direct line of sight; these field terminals are located at universities, on battlefields, or on ships. Additionally, the polar satellites store the observed environmental data and then transmit them to NOAA and Air Force ground stations when the satellites pass overhead. The ground stations then relay the data via communications satellites to the appropriate meteorological centers for processing.

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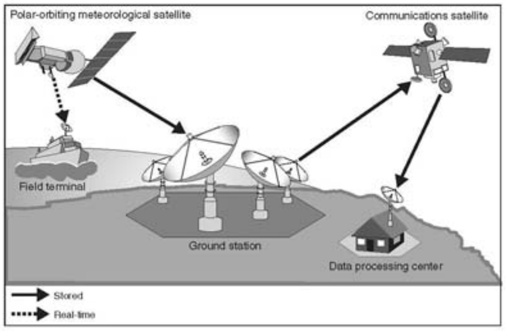
[3] Three DMSP satellites and one POES satellite remain to be launched.

Under a shared processing agreement among four satellite data processing centers—NOAA's National Environmental Satellite Data and Information Service (NESDIS), the Air Force Weather Agency, the Navy's Fleet Numerical Meteorology and Oceanography Center, and the Naval Oceanographic Office—different centers are responsible for producing and distributing, via a shared network, different environmental data sets, specialized weather and oceanographic products, and weather prediction model outputs.

Each of the four processing centers is also responsible for distributing the data to its respective users. For the DOD centers, the users include regional meteorology and oceanography centers, as well as meteorology and oceanography staff on military bases, the Naval Fleet, and mobile field sites. NESDIS forwards the data to NOAA's National Weather Service for distribution and use by government and commercial forecasters. The processing centers also use the Internet to distribute data to the general public. NESDIS is responsible for the long-term archiving of data and derived products from POES and DMSP. Figure 2 depicts a generic data relay pattern from the polar-orbiting satellites to the data processing centers and field terminals.

Figure 2: A Generic Data Relay Pattern for Polar Meteorological Satellite Systems

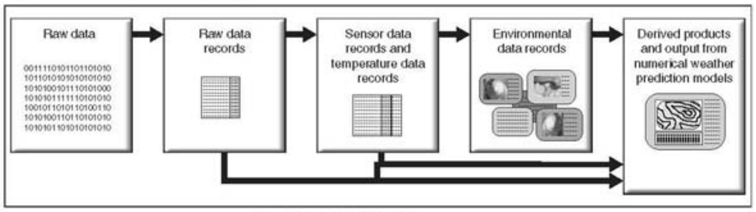


Source: GAO, based on NPOESS Integrated Program Office data.

Polar Satellite Data and Products

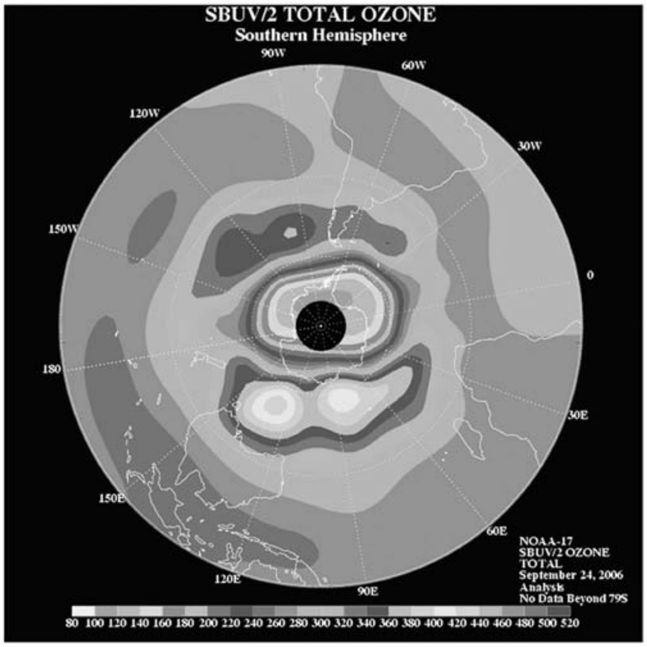
Polar satellites gather a broad range of data that are transformed into a variety of products. Satellite sensors observe different bands of radiation wavelengths, called channels, which are used for remotely determining information about the earth's atmosphere, land surface, oceans, and the space environment. When first received, satellite data are considered raw data. To make them usable, the processing centers format the data so that they are time-sequenced and include earth location and calibration information. After formatting, these data are called raw data records. The centers further process these raw data records into channel-specific data sets, called sensor data records and temperature data records. These data records are then used to derive weather and climate products called environmental data records (EDR). EDRs include a wide range of atmospheric products detailing cloud coverage, temperature, humidity, and ozone distribution; land surface products showing snow cover, vegetation, and land use; ocean products depicting sea surface temperatures, sea ice, and wave height; and characterizations of the space environment. Combinations of these data records (raw, sensor, temperature, and environmental data records) are also used to derive more sophisticated products, including outputs from numerical weather models and assessments of climate trends. Figure 3 is a simplified depiction of the various stages of satellite data processing, and figures 4 and 5 depict examples of EDR weather products.

Figure 3: Satellite Data Processing Steps



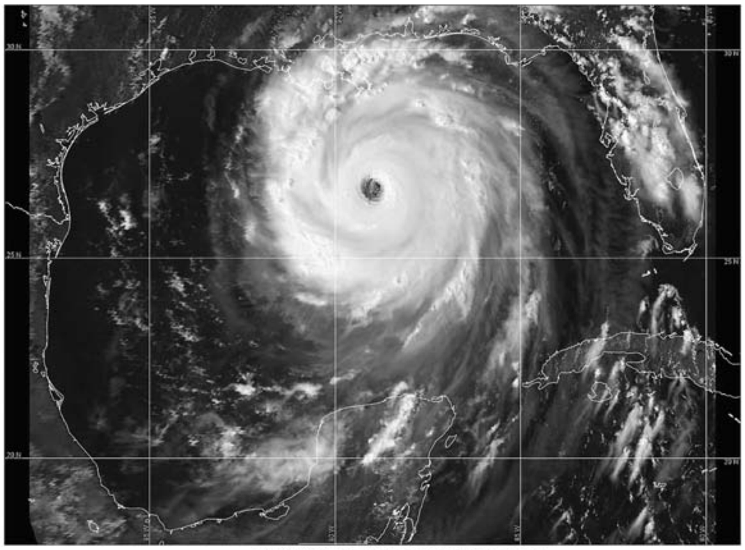
Source: GAO analysis of NOAA information.

Figure 4: Analysis of Ozone Concentration from POES Satellite Data



Source: NOAA's National Environmental Satellite Data and Information Service.

Figure 5: POES Image of Hurricane Katrina in 2005



Source: NOAA's National Environmental Satellite Data and Information Service.

NPOESS Overview

With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive required NOAA and DOD to converge the two satellite programs into a single satellite program capable of satisfying both civilian and military requirements.[3] The converged program, NPOESS, is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring through the year 2026. To manage this program, DOD, NOAA, and NASA formed the tri-agency Integrated Program Office, located within NOAA.

Within the program office, each agency has the lead on certain activities: NOAA has overall program management responsibility for the converged system and for satellite operations; DOD has the lead on the acquisition; and NASA has primary responsibility for facilitating the development and incorporation of new technologies into the converged system. NOAA and DOD share the costs of funding NPOESS, while NASA funds specific technology projects and studies. Figure 6 depicts the organizations that make up the NPOESS program office and lists their responsibilities.

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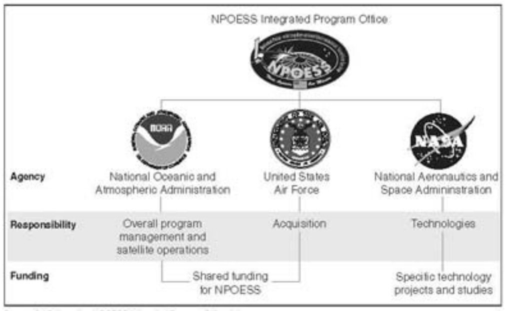
[3] Presidential Decision Directive NSTC-2, May 5, 1994.

Figure 6: Organizations Coordinated by the NPOESS Integrated Program Office


NPOESS Integrated Program Office
Agency
National Oceanic and Atmospheric Administration
United States Air Force
National Aeronautics and Space Administration
Responsibility
Overall program management and satellite operations
Acquisition
Technologies
Funding
Shared funding for NPOESS
Specific technology projects and studies

Source: GAO, based on NPOESS Integrated Program Office data.

The NPOESS program office is overseen by an Executive Committee, which is made up of the Administrators of NOAA and NASA and the Undersecretary of the Air Force.

NPOESS Acquisition Strategy

NPOESS is a major system acquisition that was originally estimated to cost about $6.5 billion over the 24-year life of the program from its inception in 1995 through 2018. The program is to provide satellite development, satellite launch and operation, and ground-based satellite data processing. These deliverables are grouped into four main categories: (1) the space segment, which includes the satellites and sensors; (2) the integrated data processing segment, which is the system for transforming raw data into EDRs and is to be located at the four processing centers; (3) the command, control, and communications segment, which includes the equipment and services needed to support satellite operations; and (4) the launch segment, which includes the launch vehicle services.

When the NPOESS engineering, manufacturing, and development contract was awarded in August 2002, the cost estimate was adjusted to $7 billion. Acquisition plans called for the procurement and launch of six satellites over the life of the program, as well as the integration of 13 instruments—consisting of 10 environmental sensors and three subsystems. Together, the sensors were to receive and transmit data on atmospheric, cloud cover, environmental, climatic, oceanographic, and solar-geophysical observations. The subsystems were to support nonenvironmental search and rescue efforts, sensor survivability, and environmental data collection activities. The program office considered 4 of the sensors to be critical because they provide data for key weather products; these sensors are in bold in table 1, which describes each of the expected NPOESS instruments.

Table 1: Expected NPOESS Instruments as of August 31, 2004 (critical sensors are in bold)

Instrument	Description
Advanced technology microwave sounder (ATMS)	Measures microwave energy released and scattered by the atmosphere and is to be used with infrared sounding data from NPOESS's cross-track infrared sounder to produce daily global atmospheric temperature, humidity, and pressure profiles.
Aerosol polarimetry sensor	Retrieves specific measurements of clouds and aerosols (liquid droplets or solid particles suspended in the atmosphere, such as sea spray, smog, and smoke).
Conical-scanned microwave imager/sounder (CMIS)	Collects microwave images and data needed to measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, and soil moisture, as well as temperature and humidity at different atmospheric levels.
Cross-track infrared sounder (CrIS)	Collects measurements of the earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.
Data collection system	Collects environmental data from platforms around the world and delivers them to users worldwide.
Earth radiation budget sensor	Measures solar short-wave radiation and long-wave radiation released by the earth back into space on a worldwide scale to enhance long-term climate studies.
Ozone mapper/profiler suite (OMPS)	Collects data needed to measure the amount and distribution of ozone in the earth's atmosphere.
Radar altimeter	Measures variances in sea surface height/topography and ocean surface roughness, which are used to determine sea surface height, significant wave height, and ocean surface wind speed and to provide critical inputs to ocean forecasting and climate prediction models.
Search and rescue satellite aided tracking system	Detects and locates aviators, mariners, and land-based users in distress.
Space environmental sensor suite	Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.
Survivability sensor	Monitors for attacks on the satellite and notifies other instruments in case of an attack.
Total solar irradiance sensor	Monitors and captures total and spectral solar irradiance data.
Visible/infrared imager radiometer suite (VIIRS)	Collects images and radiometric data used to provide information on the earth's clouds, atmosphere, ocean, and land surfaces.

Source: GAO, based on NPOESS Integrated Program Office data.

In addition, NPP was planned as a demonstration satellite to be launched several years before the first NPOESS satellite in order to reduce the risk associated with launching new sensor technologies and to ensure continuity of climate data with NASA's Earth Observing System satellites.

NPP is to host three of the four critical NPOESS sensors (VIIRS, CrIS, and ATMS), as well as one other noncritical sensor (OMPS). NPP is to provide the program office and the processing centers an early opportunity to work with the sensors, ground control, and data processing systems.

When the NPOESS development contract was awarded, the schedule for launching the satellites was driven by a requirement that the satellites be available to back up the final POES and DMSP satellites should anything go wrong during the planned launches of these satellites. In general, satellite experts anticipate that roughly 1 out of every 10 satellites will fail either during launch or during early operations after launch.

Early program milestones included (1) launching NPP by May 2006, (2) having the first NPOESS satellite available to back up the final POES satellite launch in March 2008, and (3) having the second NPOESS satellite available to back up the final DMSP satellite launch in October 2009. If the NPOESS satellites were not needed to back up the final predecessor satellites, their anticipated launch dates would have been April 2009 and June 2011, respectively.

NPOESS Experienced Cost Increases, Schedule Delays, and Technical Problems over Several Years

Over the last few years, NPOESS has experienced continued cost increases and schedule delays, requiring difficult decisions to be made about the program's direction and capabilities. In 2003, we reported that changes in the NPOESS funding stream caused a delay in the program's schedule.[4] Specifically, in late 2002, DOD shifted the expected launch date for its final DMSP satellite from 2009 to 2010. As a result, the department reduced funding for NPOESS by about $65 million between fiscal years 2004 and 2007. According to program officials, because NOAA was required to provide the same level of funding that DOD provides, this change triggered a corresponding reduction in funding by NOAA for those years. As a result of the reduced funding, program officials were forced to make difficult decisions about what to focus on first. The program office decided to keep NPP as close to its original schedule as possible because of its importance to the eventual NPOESS development and to shift some of the program's deliverables to later years. This shift affected the NPOESS deployment schedule. To plan for this shift, the program office developed a new program cost and schedule baseline.

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[4] GAO-03-987T.

After this new baseline was completed in 2004, we reported that the program office increased the NPOESS cost estimate from about $7 billion to $8.1 billion; delayed key milestones, including the planned launch of the first NPOESS satellite—which was delayed by 7 months; and extended the life of the program from 2018 to 2020.[5] The cost increases reflected changes to the NPOESS contract, as well as increased program management funds. According to the program office, contract changes included extension of the development schedule, increased sensor costs, and additional funds needed for mitigating risks. Increased program management funds were added for noncontract costs and management reserves.

At that time, we also noted that other factors could further affect the revised cost and schedule estimates. Specifically, the contractor was not meeting expected cost and schedule targets on the new baseline because of technical issues in the development of key sensors, including the critical VIIRS sensor. Based on its performance through May 2004, we estimated that the contractor would most likely overrun its contract at completion in September 2011 by $500 million—thereby increasing the projected life cycle cost to $8.6 billion. In addition, we reported that risks associated with the development of the critical sensors, integrated data processing system, and algorithms, among other things, could contribute to further cost increases and schedule slips—and we noted that continued oversight was critical. The program office's baseline cost estimate was subsequently adjusted to $8.4 billion.

In mid-November 2005, we reported that NPOESS continued to experience problems in the development of a key sensor, resulting in schedule delays and anticipated cost increases.[6] At that time, we projected that the program's cost estimate had grown to about $10 billion based on contractor cost and schedule data. We reported that the program's issues were due, in part, to problems at multiple levels of management—including subcontractor, contractor, program office, and executive leadership. Recognizing that the budget for the program was no longer executable, the NPOESS Executive Committee planned to make a decision in December 2005 on the future direction of the program—what would be delivered, at what cost, and by when. This involved deciding among options involving increased costs, delayed schedules, and reduced functionality. We noted that continued oversight, strong leadership, and timely decision making were more critical than ever and we urged the committee to make a decision quickly so that the program could proceed.

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[5] GAO-04-1054.

[6] GAO-06-249T.

However, we subsequently reported that, in late November 2005, NPOESS cost growth exceeded a legislatively mandated threshold that requires DOD to certify the program to Congress.[7] This placed any decision about the future direction of the program on hold until the certification took place in June 2006. In the meantime, the program office implemented an interim program plan for fiscal year 2006 to continue work on key sensors and other program elements using fiscal year 2006 funding.

Nunn-McCurdy Process Led to a Decision to Restructure the NPOESS Program

The Nunn-McCurdy law[8] requires DOD to take specific actions when a major defense acquisition program exceeds certain cost thresholds. In November 2005, key provisions of the act required the Secretary of Defense to notify Congress when a major defense acquisition was expected to overrun its project baseline by 15 percent or more and to certify the program to Congress when it was expected to overrun its baseline by 25 percent or more.[9] At that time, NPOESS exceeded the 25 percent threshold, and DOD was required to certify the program. Certifying a program entailed providing a determination that (1) the program is essential to national security, (2) there are no alternatives to the program that will provide equal or greater military capability at less cost, (3) the new estimates of the program's cost are reasonable, and (4) the management structure for the program is adequate to manage and control costs. DOD established tri-agency teams—made up of DOD, NOAA, and NASA experts—to work on each of the four elements of the certification process.

In June 2006, DOD (with the agreement of both of its partner agencies) certified a restructured NPOESS program, estimated to cost $12.5 billion through 2026. This decision approved a cost increase of $4 billion over the prior approved baseline cost and delayed the launch of NPP and the first two satellites by roughly 3 to 5 years. The new program also entailed establishing a stronger program management structure, reducing the number of satellites to be produced and launched from 6 to 4, and reducing the number of instruments on the satellites from 13 to 9—consisting of 7 environmental sensors and 2 subsystems. It also entailed using NPOESS satellites in the early morning and afternoon orbits and relying on European satellites for midmorning orbit data.[10] Table 2 summarizes the major program changes made under the Nunn-McCurdy certification decision.

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[7] GAO-06-573T.

[8] 10 U.S.C. § 2433 is commonly referred to as Nunn-McCurdy.

[9] 10 U.S.C. § 2433 (e)(2) has recently been amended by Pub. L. No. 109-163, § 802 (Jan. 6, 2006) and Pub. L. No. 109-364, § 213 (a) (Oct. 17, 2006).

Table 2: Summary of Changes to the NPOESS Program

Key area	Program before the Nunn-McCurdy decision	Program after the Nunn-McCurdy decision
Life cycle range	1995-2020	1995-2026
Estimated life cycle cost	$8.4 billion	$12.5 billion
Launch schedule	NPP by October 2006	NPP by January 2010
	First NPOESS by November 2009	First NPOESS by January 2013
	Second NPOESS by June 2011	Second NPOESS by January 2016
Management structure	System Program Director reports to a tri-agency steering committee and the tri-agency Executive Committee	System Program Director is responsible for day-to-day program management and reports to the Program Executive Officer
	Independent program reviews noted insufficient system engineering and cost analysis staff	Program Executive Officer oversees program and reports to the tri-agency Executive Committee
Number of satellites	6 (in addition to NPP)	4 (in addition to NPP)
Number of orbits	3 (early morning, midmorning, and afternoon)	2 (early morning and afternoon; will rely on European satellites for midmorning orbit data)
Number and complement of instruments	13 instruments (10 sensors and 3 subsystems)	9 instruments (7 sensors and 2 subsystems); 4 of the sensors are to provide fewer capabilities
Number of EDRs	55	39 (6 are to be degraded products)

Source: GAO analysis of NPOESS Integrated Program Office data.

The Nunn-McCurdy certification decision established new milestones for the delivery of key program elements, including launching NPP by January 2010,[11] launching the first NPOESS satellite (called C1) by January 2013, and launching the second NPOESS satellite (called C2) by January 2016. These revised milestones deviated from prior plans to have the first NPOESS satellite available to back up the final POES satellite should anything go wrong during that launch.

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[10] The European Organization for the Exploitation of Meteorological Satellite's MetOp program is a series of three polar-orbiting satellites dedicated to operational meteorology. MetOp satellites are planned to be launched sequentially over 14 years.

[11] According to program officials, although the Nunn-McCurdy certification decision specifies NPP is to launch by January 2010, NASA plans to launch it by September 2009 to reduce the possibility of a climate data continuity gap.

Delaying the launch of the first NPOESS satellite means that if the final POES satellite fails on launch, satellite data users would need to rely on the existing constellation of environmental satellites until NPP data becomes available—almost 2 years later. Although NPP was not intended to be an operational asset, NASA agreed to move NPP to a different orbit so that its data would be available in the event of a premature failure of the final POES satellite. However, NPP will not provide all of the operational capability planned for the NPOESS spacecraft. If the health of the existing constellation of satellites diminishes—or if NPP data is not available, timely, and reliable—then there could be a gap in environmental satellite data. Table 3 summarizes changes in key program milestones over time.

Table 3: Key Program Milestones

Milestones	As of the August 2002 contract award	As of the February 2004 rebaselined program	As of the June 2006 certification decision	Change from 2004 rebaselined program
Final POES launch[a]	March 2008	March 2008	February 2009	Not applicable
NPP launch	May 2006	October 2006	January 2010[b]	44-month delay
First NPOESS satellite planned for launch (C1)	April 2009	November 2009	January 2013	38-month delay
Final DMSP launch[a]	October 2009	May 2010	April 2012	Not applicable
Second NPOESS satellite planned for launch (C2)	June 2011	June 2011	January 2016	55-month delay

Source: GAO analysis, based on NPOESS Integrated Program Office data.

[a] POES and DMSP are not part of the NPOESS program. Their launch dates are provided to indicate the increased risk of satellite data gaps between when these systems launch and when the NPOESS satellites launch.

[b] Although the certification decision specified NPP is to launch by January 2010, NASA plans to launch it by September 2009 to reduce the possibility of a gap in climate data continuity.

In order to reduce program complexity, the Nunn-McCurdy certification decision decreased the number of NPOESS sensors from 13 to 9 and reduced the functionality of 4 sensors. Specifically, of the 13 original sensors, 5 sensors remain unchanged, 3 were replaced with less capable sensors, 1 was modified to provide less functionality, and 4 were cancelled. Table 4 shows the changes to NPOESS sensors, including the 4 identified in bold as critical sensors.

Table 4: Changes to NPOESS Instruments (critical sensors are in bold)

Instrument	Status of instrument after the Nunn-McCurdy decision	Change description
ATMS	Unchanged	Sensor is to be included on NPP and on the first and third NPOESS satellites
Aerosol polarimetry sensor	Cancelled	Sensor was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it[a]
CMIS	Replaced	CMIS sensor was cancelled, and the program office is to procure a less complex *Microwave imager/sounder* for inclusion on the second, third, and fourth NPOESS satellites
CrIS	Unchanged	Sensor is to be included on NPP and on the first and third NPOESS satellites
Data collection system	Unchanged	Subsystem is to be included on all four NPOESS satellites
Earth radiation budget sensor	Replaced	Sensor was cancelled, and is to be replaced on the first NPOESS satellite (and no others) by an existing sensor with fewer capabilities called the *Cloud's and Earth's Radiant Energy System*
OMPS	Modified	One part of the sensor, called OMPS (nadir), is to be included on NPP and on the first and third NPOESS satellites; the remaining part, called OMPS (limb), was cancelled on the NPOESS satellites, but will be included on NPP[a]
Radar altimeter	Cancelled	Sensor was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it
Search and rescue satellite aided tracking system	Unchanged	Subsystem is to be included on all four NPOESS satellites
Space environmental sensor suite	Replaced	Sensor is to be replaced by a less capable, less expensive, legacy sensor called the *Space Environment Monitor* on the first and third NPOESS satellites
Survivability sensor	Cancelled	Subsystem contract was cancelled, but could be reintegrated on future NPOESS satellites should another party choose to fund it
Total solar irradiance sensor	Cancelled	Sensor contract was cancelled but could be reintegrated on future NPOESS satellites should another party choose to fund it
VIIRS	Unchanged	Sensor is to be included on NPP and on all four NPOESS satellites

Source: GAO analysis of NPOESS Integrated Program Office data.

[a] While direct program funding for these instruments was eliminated, the instruments could be reintegrated on NPOESS satellites should other parties choose to fund them. The Nunn-McCurdy decision requires the program office to allow sufficient space on the spacecraft for these instruments and to provide the funding needed to integrate them.

The changes in NPOESS sensors affected the number and quality of the resulting weather and environmental products, called EDRs. In selecting sensors for the restructured program, the Nunn-McCurdy process placed the highest priority on continuing current operational weather capabilities and a lower priority on obtaining selected environmental and climate measuring capabilities. As a result, the revised NPOESS system has significantly less capability for providing global climate measures than was originally planned. Specifically, the number of EDRs was decreased from 55 to 39, of which 6 are of a reduced quality. The 39 EDRs that remain include cloud base height, land surface temperature, precipitation type and rate, and sea surface winds. The 16 EDRs that were removed include cloud particle size and distribution, sea surface height, net solar radiation at the top of the atmosphere, and products to depict the electric fields in the space environment. The 6 EDRs that are of a reduced quality include ozone profile, soil moisture, and multiple products depicting energy in the space environment.

Given the changes in planned sensors, program officials established a planned configuration for NPP and the four satellites of the NPOESS program, called C1, C2, C3, and C4 (see table 5). Program officials acknowledged that this configuration could change if other parties decided to develop the sensors that were cancelled. However, they noted that the planned configuration of the first satellite cannot change without increasing the risk that the launch will be delayed.

Table 5: Planned Configuration of Sensors on NPP and NPOESS Satellites

Sensor	NPP	NPOESS C1	NPOESS C2	NPOESS C3	NPOESS C4
VIIRS	X	X	X	X	X
Microwave imager/sounder (replacing CMIS)			X	X	X
CrIS	X	X		X	
ATMS	X	X		X	
Space environment monitor (replacing the space environmental sensor suite)		X		X	
OMPS	X	X		X	
Data collection system		X	X	X	X
Search and rescue satellite aided tracking system		X	X	X	X
Cloud's and earth's radiant energy system (replacing the earth radiation budget sensor)		X			

Source: GAO analysis of NPOESS Integrated Program Office data.

Earned Value Management Techniques Provide Insight on Program Cost and Schedule

To be effective, project managers need current information on a contractor's progress in meeting contract deliverables. One method that can help project managers track this progress is earned value management. This method, used by DOD for several decades, compares the value of work accomplished during a given period with that of the work expected in that period.

Differences from expectations are measured in both cost and schedule variances. Cost variances compare the earned value of the completed work with the actual cost of the work performed. For example, if a contractor completed $5 million worth of work and the work actually cost $6.7 million, there would be a –$1.7 million cost variance. Schedule variances are also measured in dollars, but they compare the earned value of the work completed with the value of work that was expected to be completed. For example, if a contractor completed $5 million worth of work at the end of the month but was budgeted to complete $10 million worth of work, there would be a –$5 million schedule variance. Positive variances indicate that activities are costing less or are completed ahead of schedule. Negative variances indicate activities are costing more or are falling behind schedule. These cost and schedule variances can then be used in estimating the cost and time needed to complete the program.

NPOESS Acquisition Restructuring Is Well Under Way, but Key Steps Remain To Be Completed

Since the June 2006 decision to revise the scope, cost, and schedule of the NPOESS program, the program office has made progress in restructuring the satellite acquisition; however, important tasks leading up to revising and finalizing contract changes remain to be completed. Restructuring a major acquisition program like NPOESS is a process that involves identifying time critical and high priority work and keeping this work moving forward, while reassessing development priorities, interdependencies, deliverables, risks, and costs. It also involves revising important acquisition documents including the memorandum of agreement on the roles and responsibilities of the three agencies, the acquisition strategy, the system engineering plan, the test and evaluation master plan, the integrated master schedule defining what needs to happen by when, and the acquisition program baseline. The Nunn-McCurdy certification decision required the Secretaries of Defense and Commerce and the Administrator of NASA to sign a revised memorandum of agreement by August 6, 2006. It also required that the program office, Program Executive Officer, and the Executive Committee revise and approve key acquisition documents including the acquisition strategy and system engineering plan by September 1, 2006, in order to proceed with the restructuring. Once these are completed, the program office can proceed to negotiate with its prime contractor on a new program baseline defining what will be delivered, by when, and at what cost.

The NPOESS program office has made progress in restructuring the acquisition. Specifically, the program office has established interim program plans guiding the contractor's work activities in 2006 and 2007 and has made progress in implementing these plans. Specifically, the program office reported that it had completed 156 of 166 key milestones[13] during fiscal year 2006—including completing ambient and thermal vacuum testing of the VIIRS engineering unit. Of the 10 remaining milestones resulting from unanticipated problems in the development of VIIRS and CrIS, 5 have since been completed, and 5 are still pending. The program office plans to complete 222 milestones in fiscal year 2007—including completing performance tests on the OMPS (nadir) sensor—and notes that they are slightly ahead of plans in that they have completed 62 milestones through January 20, 2007, which is 2 more than had been planned. Figures 7 and 8 depict the program office's progress against key milestones in fiscal year 2006 and to date in fiscal year 2007.

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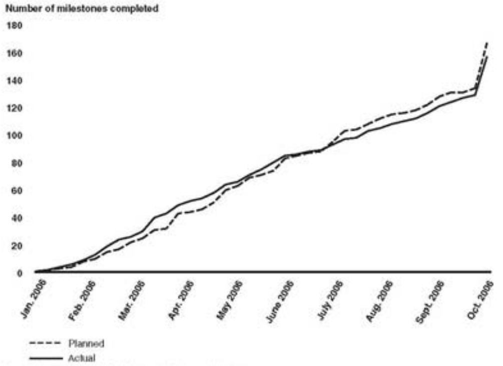
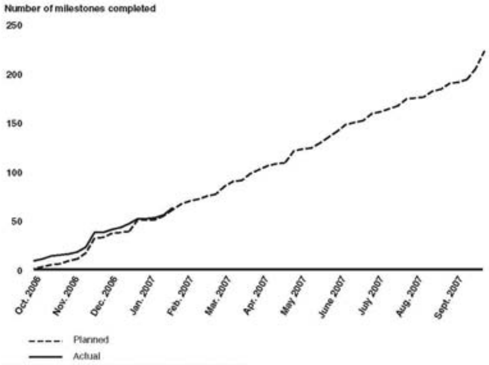
[13] The NPOESS program office selected key milestones from a much larger set of ongoing and planned milestones in order to track progress.

Figure 7: Progress on Planned Milestones in Fiscal Year 2006, as of October 1, 2006



Source: GAO analysis of NPOESS Integrated Program Office data.

Figure 8: Progress on Planned Milestones in Fiscal Year 2007, as of January 20, 2007



Source: GAO analysis of NPOESS Integrated Program Office data.

The program office has also made progress in revising key acquisition documents. It revised the system engineering plan, the test and evaluation master plan, and the acquisition strategy plan, and obtained approval of these documents by the Program Executive Officer. The program office and contractor also developed an integrated master schedule for the remainder of the program—beyond fiscal year 2007. This integrated master schedule details the steps leading up to launching NPP by September 2009, launching the first NPOESS satellite in January 2013, and launching the second NPOESS satellite in January 2016. Near-term steps include completing and testing the VIIRS, CrIS, and OMPS sensors; integrating these sensors with the NPP spacecraft and completing integration testing; completing the data processing system and integrating it with the command, control, and communications segment; and performing advanced acceptance testing of the overall system of systems for NPP.

However, key steps remain for the acquisition restructuring to be completed. These steps include obtaining the approval of the Secretaries of Commerce and Defense and the Administrator of NASA on the memorandum of agreement among the three agencies, and obtaining the approval of the NPOESS Executive Committee on key acquisition documents, including the system engineering plan, the test and evaluation master plan, and the acquisition strategy. These approvals are currently over 6 months past due. Agency officials noted that the September 1, 2006, due date for the key acquisition documents was not realistic given the complexity of coordinating documents among three different agencies, but did not provide a new estimate for when these documents would be approved.

Finalizing these documents is critical to ensuring interagency agreements and will allow the program office to move forward in completing other activities related to restructuring the program. These activities include conducting an integrated baseline review with the contractor to reach agreement on the schedule and work activities, and finalizing changes to the NPOESS development and production contract—thereby allowing the program office to lock down a new acquisition baseline cost and schedule. The program office expects to conduct an integrated baseline review by May 2007 and to finalize the contract changes by July 2007. Until key acquisition documents are finalized and approved, the program faces increased risk that it will not be able to complete important restructuring activities in time to move forward in fiscal year 2008 with a new program baseline in place. This places the NPOESS program at risk of continued delays and future cost increases.

Progress Has Been Made in Establishing an Effective NPOESS Management Structure, but Executive Turnover Will Increase Risks, and Staffing Problems Remain

The NPOESS program has made progress in establishing an effective management structure, but—almost a year after this structure was endorsed during the Nunn-McCurdy certification process—the Integrated Program Office still faces staffing problems. Over the past few years, we and others have raised concerns about management problems at all levels of the NPOESS program, including subcontractor and contractor management, program office management, and executive-level management.[13] Two independent review teams also noted a shortage of skilled program staff, including budget analysts and system engineers. Since that time, the NPOESS program has made progress in establishing an effective management structure—including establishing a new organizational framework with increased oversight by program executives, instituting more frequent subcontractor, contractor, and program reviews, and effectively managing risks and performance. However, DOD's plans for reassigning the Program Executive Officer in Summer 2007 increase the program's risks. Additionally, the program lacks a staffing process that clearly identifies staffing needs, gaps, and plans for filling those gaps. As a result, the program office has experienced delays in getting core management activities under way and lacks the staff it needs to execute day-to-day management activities.

NPOESS Program Has Made Progress in Establishing an Effective Management Structure and Increasing Oversight Activities, but Executive Turnover Will Increase Program Risks

The NPOESS program has made progress in establishing an effective management structure and increasing the frequency and intensity of its oversight activities. Over the past few years, we and others have raised concerns about management problems at all levels of management on the NPOESS program, including subcontractor and contractor management, program office management, and executive-level management. In response to recommendations made by two different independent review teams, the program office began exploring options in late 2005 and early 2006 for revising its management structure.

In November 2005, the Executive Committee established and filled a Program Executive Officer position, senior to the NPOESS Program

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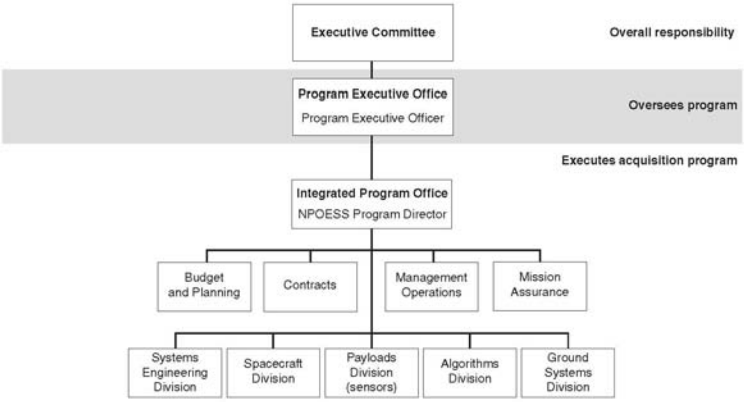
[13] GAO-06-249T; U.S. Department of Commerce, Office of the Inspector General, *Poor Management Oversight and Ineffective Incentives Leave NPOESS Program Well Over Budget and Behind Schedule*, OIG-17794-6-0001/2006 (Washington, D.C.: May 2006). In addition, two independent teams reviewed the NPOESS program in 2005: A NASA-led Independent Review Team investigated problems with the VIIRS sensor and the impact on NPP, and a DOD-led Independent Program Assessment Team assessed the broader NPOESS program. The teams briefed the NPOESS Executive Committee on their findings in August 2005 and November 2005, respectively.

Director, to streamline decision making and to provide oversight to the program. This Program Executive Officer reports directly to the Executive Committee. Subsequently, the Program Executive Officer and the Program Director proposed a revised organizational framework that realigned division managers within the Integrated Program Office responsible for overseeing key elements of the acquisition and increased staffing in key areas. In June 2006, the Nunn-McCurdy certification decision approved this new management structure and the Integrated Program Office implemented it. Figure 9 provides an overview of the relationships among the Integrated Program Office, the Program Executive Office, and the Executive Committee, as well as key divisions within the program office.

Figure 9: Overview of New Management Structure



Source: NOAA.

Operating under this new management structure, the program office implemented more rigorous and frequent subcontractor, contractor, and program reviews, improved visibility into risk management and mitigation activities, and institutionalized the use of earned value management techniques to monitor contractor performance. Specifically, program officials and the prime contractor now review the subcontractors' cost and schedule performance on a weekly basis. The information from these meetings feeds into monthly government meetings with the prime contractor to review progress against milestones, issues, and risks. Further, the Program Director conducts monthly reviews with each technical division lead to review the divisions' achievements, risks, and plans. Program officials note that these frequent reviews allow information on risks to be quickly escalated from subcontractors to contractors, to the program component level, and to the Program Director—and they allow program officials to better manage efforts to reduce risks. The program office also reported that all division leads were trained in earned value management techniques and were effectively using these techniques both to monitor subcontractor and contractor performance on a weekly basis and to identify potential problems as soon as possible.

In addition to these program office activities, the Program Executive Officer implemented monthly program reviews and increased the frequency of contacts with the Executive Committee. Specifically, the Program Executive Officer holds monthly program management reviews where the Program Director and program division leads (for example, those in charge of systems engineering or ground systems) provide briefings on the program's earned value, progress, risks, and concerns. We observed that these briefings allow the Program Executive Officer to have direct insight into the challenges and workings of the Integrated Program Office and allow risks to be appropriately escalated and addressed. These meetings also provide an open forum for managers to raise concerns and ask questions about operational challenges. For example, when NASA officials expressed concerns that vibration levels used during testing were higher than necessary and were causing damage to key sensor components, the Program Director and Program Executive Officer immediately established a forum to discuss and mitigate this issue. The Program Executive Officer briefs the Executive Committee in monthly letters, apprising committee members of the program's status, progress, risks, and earned value and the Executive Committee now meets on a quarterly basis—whereas in the recent past, we reported that the Executive Committee had met only five times in 2 years.[14]

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[14] GAO-06-249T.

While the NPOESS program has made progress in establishing an effective management structure, this progress is currently at risk. We recently reported that DOD space acquisitions are at increased risk due in part to frequent turnover in leadership positions, and we suggested that addressing this will require DOD to consider matching officials' tenure with the development or delivery of a product.[15] In March 2007, NPOESS program officials stated that DOD is planning to reassign the recently appointed Program Executive Officer in Summer 2007 as part of this executive's natural career progression. As of March 2007, the Program Executive Officer has held this position for 16 months. Given that the program is currently still being restructured, and that there are significant challenges in being able to meet critical deadlines to ensure satellite data continuity, such a move adds unnecessary risk to an already risky program.

NPOESS Program Has Filled Key Vacancies but Lacks A Programwide Staffing Process

The NPOESS program office has filled key vacancies in recent months but lacks a staffing process that identifies programwide staffing requirements and plans for filling those needed positions. Sound human capital management calls for establishing a process or plan for determining staffing requirements, identifying any gaps in staffing, and planning to fill critical staffing gaps. Program office staffing is especially important for NPOESS, given the acknowledgment by multiple independent review teams that staffing shortfalls contributed to past problems. Specifically, these review teams noted shortages in the number of system engineers needed to provide adequate oversight of subcontractor and contractor engineering activities and in the number of budget and cost analysts needed to assess contractor cost and earned value reports. To rectify this situation, the June 2006 certification decision directed the Program Director to take immediate actions to fill vacant positions at the program office with the approval of the Program Executive Officer.

Since the June 2006 decision to revise NPOESS management structure, the program office has filled multiple critical positions, including a budget officer, a chief system engineer, an algorithm division chief, and a contracts director. In addition, on an ad hoc basis, individual division managers have assessed their needs and initiated plans to hire individuals for key positions. However, almost a year after the certification, the program office still lacks a programwide process for identifying and filling all needed positions. As a result, division managers often wait months for critical positions to be filled. For example, in February 2006, the NPOESS program estimated that it needed to hire up to 10 new budget analysts. As of September 2006, none of these positions had been filled. Today, program officials estimate that they only needed to fill 7 budget analyst positions, of which 2 positions have been filled, and 5 remain vacant. Additionally, even though the certification decision directed immediate action to fill critical vacancies, the program still has vacancies in 5 systems engineering positions and 10 technical manager positions. The majority of the vacancies—4 of the 5 budget positions, 4 of the 5 systems engineering positions, and 8 of the 10 technical manager positions—are to be provided by NOAA. NOAA officials noted that each of these positions is in some stage of being filled—that is, recruitment packages are being developed or reviewed, vacancies are being advertised, or candidates are being interviewed, selected, and approved.

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[15] GAO, *Space Acquisitions: Improvements Needed in Space Acquisitions and Keys to Achieving Them*, GAO-06-626T (Washington, D.C.: Apr. 6, 2006).

The program office attributes its staffing delays to not having the right personnel in place to facilitate this process—and did not even begin to develop a staffing process—until November 2006. Program officials noted that the tri-agency nature of the program adds unusual layers of complexity to the hiring and administrative functions because each agency has its own hiring and performance management rules. In November 2006, the program office brought in an administrative officer who took the lead in pulling together the division managers' individual assessments of needed staff—currently estimated to be 25 vacant positions—and has been working with the division managers to refine this list. This new administrative officer plans to train division managers in how to assess their needs and to hire needed staff and to develop a process by which evolving needs are identified and positions are filled. However, there is as yet no date set for establishing this basic programwide staffing process.

As a result of the lack of a programwide staffing process, there has been an extended delay in determining what staff are needed and in bringing those staff on board—which has resulted in delays in performing core management activities such as establishing the program office's cost estimate and bringing in needed contracting expertise. Additionally, until a programwide staffing process is in place, the program office risks not having the staff it needs to execute day-to-day management activities.

Methodology Supporting the June 2006 Cost and Schedule Estimate Was Reliable, but Recent Events Could Increase Program Costs

In June 2006, DOD certified a restructured NPOESS program that was estimated to cost $11.5 billion for the acquisition portion of the program[16] and scheduled to launch the first satellite in 2013. The Office of the Secretary of Defense's Cost Analysis Improvement Group (cost analysis group)—the independent cost estimators charged with developing the estimate for the acquisition portion of the program—used an acceptable methodology to develop this estimate. When combined with an estimated $1 billion for operations and support after launch, this brings the program life cycle cost to $12.5 billion. Recent events, however, could further increase program costs or delay schedules. Specifically, the program continues to experience technical problems on key sensors, and costs and schedules will be adjusted during negotiations on contract changes. The NPOESS program office is developing its own cost estimate to refine the one developed in June 2006 that it will use to negotiate contract changes. A new baseline cost will be established once the contract is finalized.

Certified Program Estimates Were Developed Using an Acceptable Methodology

The cost and schedule estimate for the restructured NPOESS program was developed by DOD's cost analysis group using an acceptable methodology. Cost-estimating organizations throughout the federal government and industry use certain key practices—related to planning, conducting, and reporting the estimate—to ensure a sound estimate. Table 6 lists the elements of a sound cost estimating methodology. In addition, to ensure the validity of the data assumptions that go into the estimate, leading organizations use actual historical costs and seek an independent validation of critical cost drivers.

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[16] The acquisition portion of the program includes satellite development, production, and launch. It does not include operations and support costs after launch.

Table 6: Elements of a Sound Cost Estimating Methodology

Activity area	Key practices
Planning the estimate	Define the estimate's purpose
	Define the program or system characteristics
	Identify ground rules and assumptions
	Determine the estimating approach
	Develop the estimating plan
Conducting the estimate	Obtain the data
	Perform the estimate
	Conduct a risk and uncertainty analysis
	Conduct a sensitivity analysis
Reporting the estimate	Document the estimate
	Review and provide results
	Update the estimate with actual cost data and document lessons learned

Source: GAO analysis of leading practices.

DOD's cost analysis group used an acceptable methodology in developing the NPOESS cost estimate in that they planned, conducted, and reported the estimate consistent with leading practices. The cost analysis group's cost estimating approach was largely driven by the program's principal "ground rule" to maintain the continuity of weather data without a gap. Specifically, the cost analysis group assessed two risks: (1) the uncertainty of the health of the current polar-satellite constellation and (2) the uncertainty of when the new satellite system could be delivered (including the time needed to evaluate new satellites once in orbit). The resulting analysis showed that the restructured NPOESS system could be delivered and the first satellite launched by 2013 with a high level of confidence in maintaining satellite data continuity.[17]

To determine specific costs, the group used the existing work breakdown structure employed by the program office as the basis for performing its work. This work breakdown structure consists of seven major elements, including ground systems; spacecraft; sensors; assembly, integration and test; system engineering/contractor program management; government program management; and launch.

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[17] The cost analysis group determined that there was a 90 percent confidence level that there would be no weather coverage gap.

The cost analysis group also took steps to ensure the validity of the data that went into the estimate. For each element, the cost analysis group visited all major contractor sites to collect program data including

- schedule (including the original, rebaselined, and current schedules, and risks affecting the current schedule);
- current staffing profile by month;
- the history of staffing used;
- the qualifications of people charging the program;
- the program's technical approaches;
- system diagrams;
- bills of materials;
- funding profile; and
- the contractor's program legacy (a justification that the contractor has worked on similar projects in the past and that the contractor should be able to adapt that knowledge to the current work).

The cost analysis group also compared this data with contractor labor rates from the Defense Contract Management Agency and obtained NASA's validation of the costs associated with the most significant cost driver, the VIIRS sensor.

Since schedule was the primary uncertainty factor in the cost analysis, it also was the driver of overall costs. Specifically, the cost analysis group took its risk-adjusted schedule durations for the major cost elements and adjusted the contractor-submitted manning profiles accordingly. They then used NPOESS historical data on labor rates and materials to calculate the cost of these elements.

Consistent with DOD practice, the cost analysis group established its cost estimate at a 50 percent confidence level.[18] However, cost analysts could not provide an upper limit for potential cost growth, explaining that the program contains "failsafe" measures to use alternative technologies (such as using legacy systems) if schedules are delayed and costs increase. As a result, cost analysts reported that they have a high level of confidence that acquisition costs will not exceed $11.5 billion—but a lower level of confidence that the configuration of sensors will remain unchanged.

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[18] A 50 percent level of confidence indicates that NPOESS has a 50 percent chance that the restructured program (as defined in the Nunn-McCurdy certification decision) will be delivered as planned at the acquisition cost of $11.5 billion.

Recent Events Could Lead to Increased Program Costs or Delayed Schedules

While the June 2006 cost estimate for the acquisition portion of the program was reasonable at the time it was made, several recent events could cause program life cycle costs to grow or schedules to be delayed. Specifically, the program continues to experience technical problems on key sensors. The CrIS sensor being developed for the NPP satellite suffered a major structural failure in October 2006. A failure review board is currently working to resolve the root causes of the failure. While program officials note that they should be able to cover costs related to investigating the problem, the full cost and schedule to fix the sensor is not yet known. Also, VIIRS development, which has been the program's primary cost driver, is not yet complete and continues to be a high-risk development. This too, could lead to higher final program costs or delayed schedules.

Program costs are also likely to be adjusted during upcoming negotiations on contract changes. The NPOESS program office is developing its own cost estimate to refine the one developed in June 2006. Program officials plan to use this revised cost estimate to negotiate contract changes. A new baseline cost will be established once the contract is finalized—an event that the Program Director expects to occur by July 2007.

Major Program Segments Are Under Development, but Significant Risks Remain

Major segments of the NPOESS program—the space segment, the ground systems segment, and the launch segment—are under development; however, significant problems have occurred and risks remain. The program office is aware of these risks and is working to mitigate them, but continued problems could affect the program's overall cost and schedule. Given the tight time frames for completing key sensors, integrating them on the NPP spacecraft, and getting the ground-based data processing systems developed, tested, and deployed, it will be important for the NPOESS Integrated Program Office, the Program Executive Office, and the Executive Committee to continue to provide close oversight of milestones and risks.

Space Segment—Progress Made, but Key Sensors Continue to Face Major Risks

The space segment includes the sensors and the spacecraft. Four sensors are of critical importance—VIIRS, CrIS, OMPS, and ATMS—because they are to be launched on the NPP satellite. Initiating work on another sensor, the Microwave imager/sounder, is also important because this new sensor—replacing the cancelled CMIS sensor—will need to be developed in time for the second NPOESS satellite launch. Over the past year, the program made progress on each of the sensors and the spacecraft. However, two sensors, VIIRS and CrIS, have experienced major problems. The status of each of the components of the space segment is described in table 7.

Table 7: Status of Selected Components of the Space Segment, as of April 2007

Space segment component	Risk level	Status
VIIRS	High	VIIRS development has continued in 2006 and in early 2007. In December 2006, the contractor completed environmental tests of VIIRS' engineering design unit (a prototype) and identified three problems.[a] While these problems were being studied, the program office approved the delivery of the engineering unit to the subcontractor responsible for integration and testing on NPP. In late February 2007, program officials determined that the contractor was able to mitigate all but one of the problems, and they approved the flight unit to proceed to system level integration with a goal of resolving the final problem before a technical readiness review milestone in May 2007. VIIRS flight unit is scheduled to be delivered to NPP by July 2008.
CrIS	High	Development of CrIS was put on hold in October 2006 when the flight unit designated to go on NPP experienced a major structural failure during its vibration testing. As of March 2007, a failure review board established by the contractors and the NPOESS program office identified causes for failure and has planned an approach to completing flight unit development and delivery for NPP. The review board has also initiated inspections of all sensor modules and subsystems for damage. The program office expects to restart acceptance testing in July 2007, and the CrIS flight unit is expected to be delivered to NPP by February 2008.
OMPS	Moderate	As part of the Nunn-McCurdy certification in June 2006, one element of the OMPS sensor, called OMPS (limb), was removed from the program. In February 2007, program officials agreed to reintegrate OMPS (limb) on NPP if NOAA and NASA would fund it. This funding was approved in early April 2007. OMPS is currently on schedule for delivery to NPP by May 2008; however, there are concerns that the OMPS flight unit delivery will be so late in the integration testing process that there could be an insufficient schedule margin, should a problem arise.
ATMS	Low	The ATMS flight unit for NPP was developed by a NASA contractor and delivered to the program in October 2005. NASA integrated the flight unit on the spacecraft and is awaiting delivery of the other sensors in order to complete integration testing.
Microwave imager/ sounder	Not yet rated	A new microwave imager/sounder sensor is being planned to replace the cancelled CMIS sensor. It is planned to be ready for launch on the second NPOESS satellite. In October 2006, the program office issued a request for information seeking industry ideas for the design of the new sensor, and responses were due by the end of December 2006. The program office anticipates awarding a contract to develop the sensor by October 2008.

Space segment component	Risk level	Status
Spacecraft	Low	The development of the spacecrafts for NPP and NPOESS are on track. The NPP spacecraft was completed in June 2005. Integration testing will be conducted once the NPP sensors are delivered. Early issues with the NPOESS spacecraft (including issues with antennas and a data storage unit) have been resolved; however, risks remain that could delay the completion of the spacecraft. A key risk involves delays in the delivery of the solar array, which may arrive too late to be included in some key testing. Other risks associated with the electrical power subsystem are taking longer than anticipated to resolve.

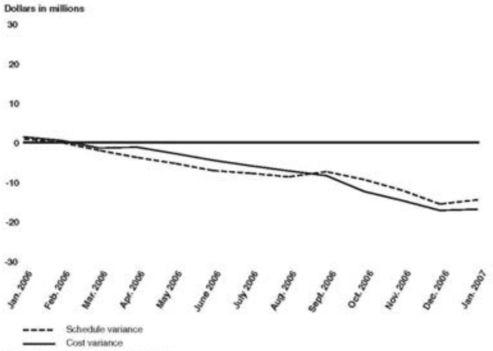
Source: GAO analysis of NPOESS Integrated Program Office data.

[a] The three problems are (1) band-to-band co-registration, an issue in which band registration shifts with different temperatures; (2) cross-talk, which involves information from sensor cells leaking into other cells; and (3) line-spread function issues, in which the instrument's focus changes with changes in temperature.

Earned Value Data Show Problems on the Space Segment

Earned value management tools are used to compare the value of work accomplished with the work expected during a given time period, and any differences are measured in cost and schedule variances. The NPOESS space segment experienced negative cost and schedule variances between January 2006 and January 2007 (see fig. 10).

Figure 10: Cumulative Cost and Schedule Variance for the NPOESS Space Segment over a 13-Month Period



Source: GAO analysis based on contractor data.

From January 2006 to January 2007, the contractor exceeded cost targets for the space segment by $17 million—which is 4 percent of the space segment budget for that time period. Similarly, the contractor was unable to complete $14.6 million worth of work in the space segment. The main factors in the cost and schedule variances were due to underestimation of the scope of work, pulling resources from lower priority tasks to higher priority items, and unforeseen design issues on key sensors. For example, VIIRS continued to experience negative cost variance trends due to unplanned efforts, which included refurbishing and recertifying the VIIRS calibration chamber, completing the testing of the engineering design unit, and resolving a problem with the testing equipment needed to adjust VIIRS' temperature during a key test.

Unplanned efforts for CrIS that attributed to the negative cost and schedule variances included additional time required for testing and material management. The schedule variances for VIIRS and CrIS were mainly due to resources being pulled from other areas to support higher priority tasks, extended testing and testing delays, management changes, and improper material handling. Further, there is a high likelihood that CrIS will continue to experience cost and schedule variances against the fiscal year 2007 interim program plan until the issues that caused its structural failure are addressed.

Program Office Is Monitoring Sensor Risks and Evaluating Options

Program officials regularly track risks associated with various NPOESS components and work to mitigate them. Having identified both VIIRS and CrIS as high risk, OMPS as a moderate risk, and the other components as low risk, the program office is working closely with the contractors and subcontractors to resolve sensor problems.

Program officials have identified work-arounds that will allow them to move forward in testing the VIIRS engineering unit and have approved the flight unit to proceed to a technical readiness review milestone in May 2007. Regarding CrIS, as of March 2007, a failure review board identified root causes of its structural failure, identified plans for resolving them, and initiated inspections of sensor modules and subsystems for damage. An agency official reported that there is sufficient funding in the fiscal year 2007 program office's and contractor's management reserve funds to allow for troubleshooting both VIIRS and CrIS problems. However, until the CrIS failure review board fully determines the amount of rework that is necessary to fix the problems, it is unknown if additional funds will be needed or if the time frame for CrIS' delivery will be delayed. According to agency officials, CrIS is not on the program schedule's critical path, and there is sufficient schedule margin to absorb the time it will take to conduct a thorough failure review process.

Managing the risks associated with the development of VIIRS and CrIS are of particular importance because these are to be demonstrated on the NPP satellite currently scheduled for launch in September 2009. Additionally, any delay in the NPP launch date could affect the overall NPOESS program because the success of the program depends on the lessons learned in data processing and system integration from the NPP satellite.

Ground Segment—Progress Has Been Made, but Work Remains

Development of the ground segment—which includes the interface data processing system, the ground stations that are to receive satellite data, and the ground-based command, control, and communications system—is under way and on track. However, important work pertaining to developing the algorithms that translate satellite data into weather products within the integrated data processing segment remains to be completed. Table 8 describes each of the components of the ground segment and identifies the status of each. Additionally, appendix II provides an overview of satellite data processing algorithms.

Table 8: Status of Ground Segment Components

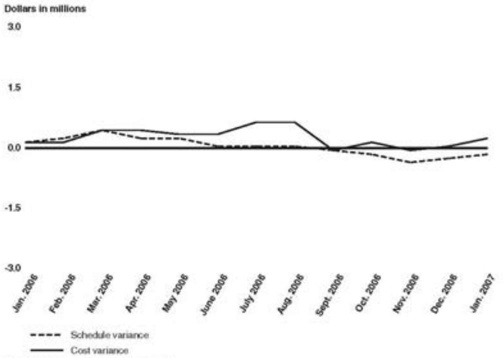
Ground segment component/description	Risk level	Status
Interface Data Processing System (IDPS) A ground-based system that is to process the sensors' data so that they are usable by the data processing centers and the broader community of environmental data users. IDPS will be deployed at the four weather data processing centers.	Moderate	IDPS is being developed in a series of builds. Currently, IDPS build 1.4 has been delivered for testing and recently passed two key data transfer tests. Contractors are currently working to develop IDPS build 1.5, which is expected to be the build that will be used with NPP. However, work remains in three areas: system latency, algorithm performance, and calibration and validation planning. • *Latency*—IDPS must process volumes of data within 65 minutes to meet NPP requirements. The contractor has made progress in reducing the latency of the system's data handling from 93 minutes to 73 minutes and is working to reduce it by 8 minutes more by resolving data management issues, increasing the number of processors, and increasing algorithm efficiency. • *Algorithm performance*—IDPS algorithms are the mathematical functions coded into the system software that transform raw data into data products including sensor data records and environmental data records. IDPS build 1.4 contains provisional algorithms, which are being refined as the sensors complete various stages of testing. Because some sensors are delayed, full characterization of those sensors in order to refine the algorithms has also been delayed and may not be completed in time for the delivery of IDPS build 1.5 in early 2009. If this occurs, agency officials plan to improve the algorithms in build 1.5 during a planned maintenance upgrade prior to NPP launch. • *Calibration/validation*—Calibration/validation is the process for tweaking algorithms to provide more accurate observations. The contractor has documented a detailed schedule for calibration and validation during IDPS development and is developing a postlaunch task list to drive prelaunch preparation efforts. However, much work and uncertainty continue to exist in the calibration and validation area. A program official noted that, while teams can do a lot of preparation work, including building the infrastructure to allow sensor testing and having a good understanding of the satellite, sensors, and available data for calibration, many issues need to take place after launch.
Ground stations for receiving satellite data 15 unmanned ground stations around the world (called SafetyNet™) are to receive satellite data and send it to the four data processing centers.	Low	NOAA is working with domestic and foreign authorities to gain approval to operate ground stations to receive satellite data. According to agency officials, the full complement of ground stations will not be in place in time for the C1 launch: however, the ground stations will be phased in by the launch of C2. To date, the program office has reached agreement with 4 of 15 ground station sites.
Command, control, and communications segment Performs the day-to-day monitoring and command of the spacecraft and sensors.	Low	NOAA recently completed moving its satellite command, control, and communications capabilities to a new office building. In addition, the command, control, and communications segment acceptance testing for NPP has been completed. The segment is expected to begin operation in 2008.

Source: GAO analysis of NPOESS Integrated Program Office data.

Ground Segment Cost and Schedule Are on Track; Work and Risks Remain

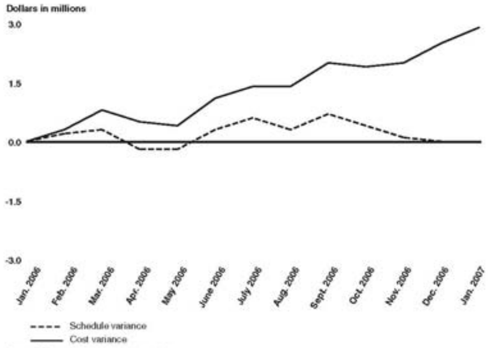
Using contractor-provided data, our analysis indicates cost and schedule performance on key elements of the NPOESS ground segment were generally on track or positive against the fiscal year 2006 and 2007 interim program plans. For the IDPS component, the contractor completed slightly less work than planned and finished slightly under budget. This caused cost and schedule variances of less than 1 percent off of expectations. (see fig. 11). For the command, control, and communications component, the contractor was able to outperform its planned targets by finishing under budget by $3 million (6.2 percent of the budget for this time period) and by completing $31,000 (less than 1 percent) worth of work beyond what was planned (see fig. 12).

Figure 11: Cumulative Cost and Schedule Variance for the NPOESS IDPS Development over a 13-Month Period



Source: GAO analysis based on contractor data.

Figure 12: Cumulative Cost and Schedule Variance for the NPOESS Command, Control, and Communications Segment over a 13-Month Period



Source: GAO analysis based on contractor data.

Program Office Has Plans to Address IDPS Risks

The NPOESS program office plans to continue to address risks facing IDPS development. Specifically, the IDPS team is working to reduce data processing delays by seeking to limit the number of data calls, improve the efficiency of the data management system, increase the efficiency of the algorithms, and increase the number of processors. The program office also developed a resource center consisting of a logical technical library, a data archive, and a set of analytical tools to coordinate, communicate, and facilitate the work of algorithm subject matter experts on algorithm development and calibration/validation preparations. Managing the risks associated with the development of the IDPS system is of particular importance because this system will be needed to process NPP data.

Launch Segment—NPP Launch Preparation Has Begun, while NPOESS Launch Planning Remains a Future Event

Different agencies are responsible for launching NPP and NPOESS. NASA is responsible for the NPP launch and began procuring the launch vehicle for NPP in August 2006. Program officials expect to have it delivered by July 2009, less than 2 months before the scheduled NPP launch in September 2009.

The NPOESS Integrated Program Office is responsible for launching the NPOESS satellites. According to program officials, the Air Force is to procure launch services for the program through DOD's Evolved Expendable Launch Vehicle contract. These services are to be procured by January 2011, 2 years before the first scheduled launch.

Conclusions

NPOESS restructuring is well under way, and the program has made progress in establishing an effective management structure. However, key steps remain in restructuring the acquisition, including completing important acquisition documents such as the system engineering plan, the acquisition program baseline, and the memorandum of agreement documenting the three agencies' roles and responsibilities. Until these key documents are finalized, the program is unable to finalize plans for restructuring the program. Additionally, the program office continues to have difficulty filling key positions and lacks a programwide staffing process. Until the program establishes an effective and repeatable staffing process, it will have difficulties in identifying and filling its staffing needs in a timely manner. Having insufficient staff in key positions impedes the program office's ability to conduct important management and oversight activities, including revising cost and schedule estimates, monitoring progress, and managing technical risks. The program faces even further challenges if DOD proceeds with plans to reassign the Program Executive Officer this summer. Such a move would add unnecessary risk to an already risky program.

In addition, the likelihood exists that there will be further cost increases and schedule delays because of technical problems on key sensors and pending contract negotiations. Major program segments—including the space and ground segments—are making progress in their development and testing. However, two critical sensors have experienced problems and are considered high risk, and risks remain in developing and implementing the ground-based data processing system. Given the tight time frames for completing key sensors, integrating them, and getting the ground-based data processing systems developed, tested, and deployed, continued close oversight of milestones and risks is essential to minimize potential cost increases and schedule delays.

Recommendations for Executive Action

Because of the importance of effectively managing the NPOESS program to ensure that there are no gaps in the continuity of critical weather and environmental observations, we are making recommendations to the Secretaries of Defense and Commerce and to the Administrator of NASA to ensure that the responsible executives within their respective organizations approve key acquisition documents, including the memorandum of agreement among the three agencies, the system engineering plan, the test and evaluation master plan, and the acquisition strategy, as quickly as possible but no later than April 30, 2007.

We are also recommending that the Secretary of Defense direct the Air Force to delay reassigning the recently appointed Program Executive Officer until all sensors have been delivered to the NPOESS Preparatory Program; these deliveries are currently scheduled to occur by July 2008.

We are also making two additional recommendations to the Secretary of Commerce. We recommend that the Secretary direct the Undersecretary of Commerce for Oceans and Atmosphere to ensure that NPOESS program authorities develop and implement a written process for identifying and addressing human capital needs and for streamlining how the program handles the three different agencies' administrative procedures, and establish a plan for immediately filling needed positions.

Agency Comments and Our Evaluation

We received written comments on a draft of this report from the Deputy Secretary of the Department of Commerce (see app. III), the Deputy Assistant Secretary for Networks and Information Integration of the Department of Defense (see app. IV), and the Deputy Administrator of the National Aeronautics and Space Administration (see app. V). All three agencies agreed that it was important to finalize key acquisition documents in a timely manner, and DOD proposed extending the due dates for the documents to July 2, 2007. Because the NPOESS program office intends to complete contract negotiations by July 4, 2007, we remain concerned that any further delays in approving the documents could delay contract negotiations and thus increase the risk to the program.

In addition, the Department of Commerce agreed with our recommendation to develop and implement a written process for identifying and addressing human capital needs and to streamline how the program handles the three different agencies' administrative procedures. The department also agreed with our recommendation to plan to immediately fill open positions at the NPOESS program office. Commerce noted that NOAA identified the skill sets needed for the program and has implemented an accelerated hiring model and schedule to fill all NOAA positions in the NPOESS program. The department also stated that the Program Director will begin presenting the detailed staffing information at monthly program management reviews, including identifying any barriers and recommended corrective actions. Commerce also noted that NOAA has made NPOESS hiring a high priority and has documented a strategy—including milestones—to ensure that all 20 needed positions are filled by June 2007.

DOD did not concur with our recommendation to delay reassigning the Program Executive Officer, noting that the NPOESS System Program Director responsible for executing the acquisition program would remain in place for 4 years. The Department of Commerce also noted that the Program Executive Officer position is planned to rotate between the Air Force and NOAA. Commerce also stated that a selection would be made prior to the departure of the current Program Executive Officer to provide an overlap period to allow for knowledge transfer and ensure continuity.

However, over the last few years, we and others (including an independent review team and the Commerce Inspector General) have reported that ineffective executive-level oversight helped foster the NPOESS program's cost and schedule overruns. We remain concerned that reassigning the Program Executive at a time when NPOESS is still facing critical cost, schedule, and technical challenges will place the program at further risk.

While it is important that the System Program Director remain in place to ensure continuity in executing the acquisition, this position does not ensure continuity in the functions of the Program Executive Officer. The current Program Executive Officer is experienced in providing oversight of the progress, issues, and challenges facing NPOESS and coordinating with Executive Committee members, as well as DOD authorities responsible for executing Nunn-McCurdy requirements. Additionally, while the Program Executive Officer position is planned to rotate between agencies, the memorandum of agreement documenting this arrangement is still in draft and should be flexible enough to allow the current Program Executive Officer to remain until critical risks have been addressed.

Further, while Commerce plans to allow a period of overlap between the selection of a new Program Executive Officer and the departure of the current one, time is running out. The current Program Executive Officer is expected to depart in early July 2007 and, as of mid-April 2007, a successor has not yet been named. NPOESS is an extremely complex acquisition, involving three agencies, multiple contractors, and advanced technologies.

There is not sufficient time to transfer knowledge and develop the sound professional working relationships that the new Program Executive Officer will need to succeed in that role. Thus, we remain convinced that given NPOESS's current challenges, reassigning the current Program Executive Officer at this time would not be appropriate.

All three agencies also provided technical comments, which we have incorporated in this report as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to interested congressional committees, the Secretary of Commerce, the Secretary of Defense, the Administrator of NASA, the Director of the Office of Management and Budget, and other interested parties. In addition, this report will be available at no charge on our Web site at http://www.gao.gov.

If you have any questions on matters discussed in this report, please contact me at (202) 512-9286 or by e-mail at pownerd@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VI.

David a. Pow

Director, Information Technology
Management Issues

Appendix I: Objectives, Scope, and Methodology

Our objectives were to (1) evaluate the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program office's progress in restructuring the acquisition; (2) evaluate the program office's progress in establishing an effective management structure; (3) assess the reliability of the new life cycle cost estimate and proposed schedule; and (4) identify the status and key risks facing the program's major segments (the launch, space, data processing, and ground control segments) and evaluate the adequacy of the program's efforts to mitigate these risks.

To evaluate the NPOESS program office's progress in restructuring the acquisition program, we reviewed the program's Nunn-McCurdy certification decision memo and program documentation including status briefings and milestone progress reports. We also interviewed program office officials and attended conferences and senior-level management program review meetings to obtain information on the program's acquisition restructuring.

To evaluate the program office's progress in establishing an effective management structure, we reviewed the Nunn-McCurdy decision memo for the program, as well as program documentation and briefings. We assessed the status of efforts to implement recommendations regarding the program's management structure, including the work of the team responsible for reviewing the management structure under the Nunn-McCurdy review. We also analyzed the program office's organizational charts and position vacancies. Finally, we interviewed officials responsible for reviewing the management structure of the program under Nunn-McCurdy, attended senior-level management review meetings to obtain information related to the program's progress in establishing and staffing the new management structure, and interviewed program office officials responsible for human capital issues to obtain clarification on plans and goals for the new management structure.

To assess the reliability of the new life cycle cost estimate and proposed schedule, we analyzed the Office of the Secretary of Defense's Cost Analysis Improvement Group's (cost analysis group) cost estimating methodology and the assumptions used to develop its independent cost estimate. Specifically, we assessed the cost estimating group's methodology against 12 best practices recognized by cost-estimating organizations within the federal government and industry for the development of reliable cost estimates. These best practices are also contained in a draft version of our cost guide, which is currently being developed by GAO cost experts. We also assessed cost- and schedule-related data, including the work breakdown structure and detailed schedule risk analyses to determine the reasonableness of the cost analysis group's assumptions. We also interviewed cost analysis group officials to obtain clarification on cost and schedule estimates and their underlying assumptions. Further, we interviewed program officials to identify any assumptions that may have changed.

To identify the status and key risks facing the program's major segments (the launch, space, data processing, and ground control segments) and to evaluate the adequacy of the program's efforts to mitigate these risks, we reviewed the program's Nunn-McCurdy certification decision memo and other program documentation. We analyzed briefings and monthly program management documents to determine the status and risks of the key program segments. We also analyzed earned value management data obtained from the contractor to assess the contractor's performance to cost and schedule. We reviewed cost reports and program risk management documents and interviewed program officials to determine the program segments' risks that could negatively affect the program's ability to maintain the current schedule and cost estimates. We also interviewed agency officials from the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD), and the NPOESS program office to determine the status and risks of the key program segments. Finally, we observed senior-level management review meetings and attended conferences to obtain information on the status of the NPOESS program.

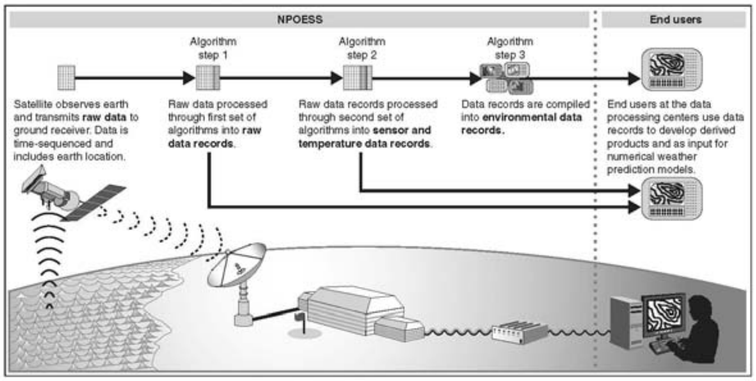
We performed our work at the NPOESS Integrated Program Office and at DOD, NASA, and NOAA offices in the Washington, D.C., metropolitan area between July 2006 and April 2007 in accordance with generally accepted government auditing standards.

Appendix II: Overview of Satellite Data Processing Algorithms and the Calibration and Validation Process

Algorithms are sets of instructions, expressed mathematically, that translate satellite sensor measurements into usable information. In the NPOESS program, government contractors are responsible for algorithm development; the program office is responsible for independently validating the algorithms. Scientists develop these algorithms, which are then written as computer code to be incorporated into the interface data processing system (IDPS) operational system. The NPOESS ground system uses three primary types of algorithms:

- Algorithms to develop raw data records "unpack" the digital packets received by the antennas/IDPS (the ones and zeros) and sent from the satellite, associate the data with the information about the satellite's location and, finally, translate it back into the data it was when it started at the sensor.
- Algorithms used to develop sensor and temperature data records allow the on-ground users to understand what the sensor saw. It translates the information from the sensor into a measure of the various forms of energy (e.g., brightness, temperature, radiance).
- Algorithms used to produce the weather products called environmental data records (EDR) are crosscutting. They combine various data records, as well as other data, in order to produce measures useful to scientists. Additionally, EDRs can be "chained"—that is, the output of one EDR algorithm will become an input into the next EDR algorithm. To illustrate, cloud detection/mask is an important "base" EDR because many EDRs, like sea surface temperature, are only calculated when clouds are not present. Figure 13 shows the flow of the data and algorithms.

Figure 13: Satellite Data Processing Algorithms

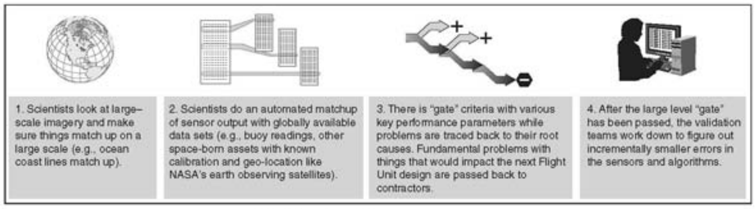

NPOESS
End users
Algorithm step 1
Algorithm step 2
Algorithm step 3
Satellite observes earth and transmits **raw data** to ground receiver. Data is time-sequenced and includes earth location.
Raw data processed through first set of algorithms into **raw data records**.
Raw data records processed through second set of algorithms into **sensor and temperature data records**.
Data records are compiled into **environmental data records.**
End users at the data processing centers use data records to develop derived products and as input for numerical weather prediction models.

Sources: GAO (analysis), NASA (images).

A corollary to algorithm development is the calibration and validation process. According to a senior algorithm scientist, in this process, once the satellite has been launched, scientists verify that the sensors accurately report what ground conditions are. For example, one EDR from the visible/infrared imager radiometer suite (VIIRS) is "ocean color." Once the sensor is in orbit, scientists can compare the results that the VIIRS sensor reports on ocean color with the known results from sensors on ocean buoys that also measure ocean color in select locations. Then, if the sensors do not accurately report the ground conditions, scientists can calibrate, or "tweak," the algorithms used to develop sensor, temperature, and environmental data records to report on ground conditions more accurately.

According to an agency official, fully calibrating a simple sensor once it has been launched can take approximately a year. A more complicated sensor can take 18 months to 2 years (see fig. 14).

Figure 14: Describes the High-Level Calibration and Validation Process



1. Scientists look at large–scale imagery and make sure things match up on a large scale (e.g., ocean coast lines match up).

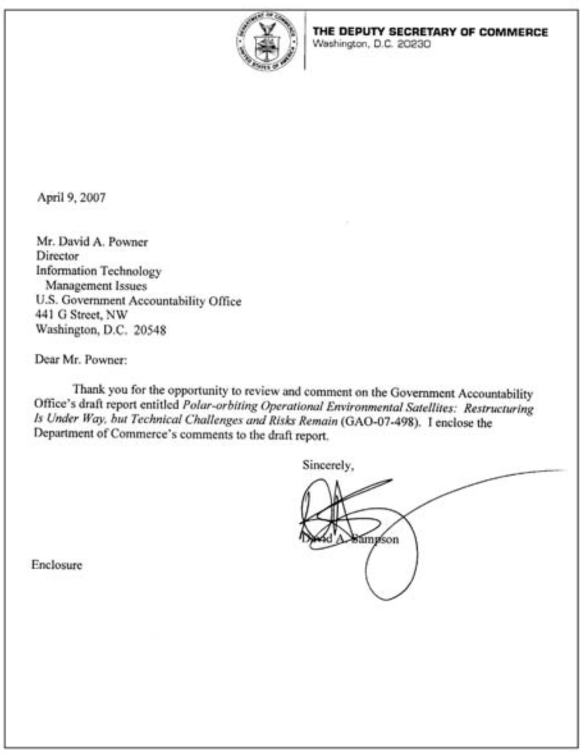
2. Scientists do an automated matchup of sensor output with globally available data sets (e.g., buoy readings, other space-born assets with known calibration and geo-location like NASA's earth observing satellites).

3. There is "gate" criteria with various key performance parameters while problems are traced back to their root causes. Fundamental problems with things that would impact the next Flight Unit design are passed back to contractors.

4. After the large level "gate" has been passed, the validation teams work down to figure out incrementally smaller errors in the sensors and algorithms.

Sources: GAO and Map Resources.

Appendix III: Comments from the Department of Commerce



THE DEPUTY SECRETARY OF COMMERCE
Washington, D.C. 20230

April 9, 2007

Mr. David A. Powner
Director
Information Technology
Management Issues
U.S. Government Accountability Office
441 G Street, NW
Washington, D.C. 20548

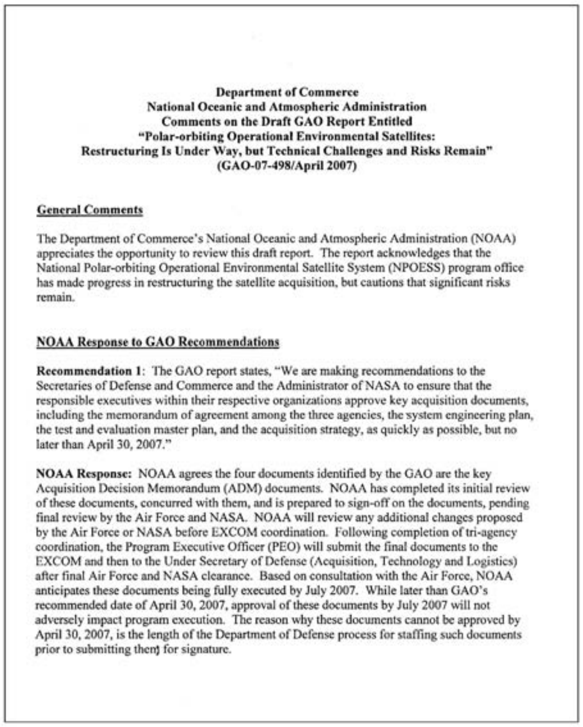
Dear Mr. Powner:

Thank you for the opportunity to review and comment on the Government Accountability Office's draft report entitled *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain* (GAO-07-498). I enclose the Department of Commerce's comments to the draft report.

Sincerely,

David A. Sampson

Enclosure



Department of Commerce
National Oceanic and Atmospheric Administration
Comments on the Draft GAO Report Entitled
"Polar-orbiting Operational Environmental Satellites:
Restructuring Is Under Way, but Technical Challenges and Risks Remain"
(GAO-07-498/April 2007)

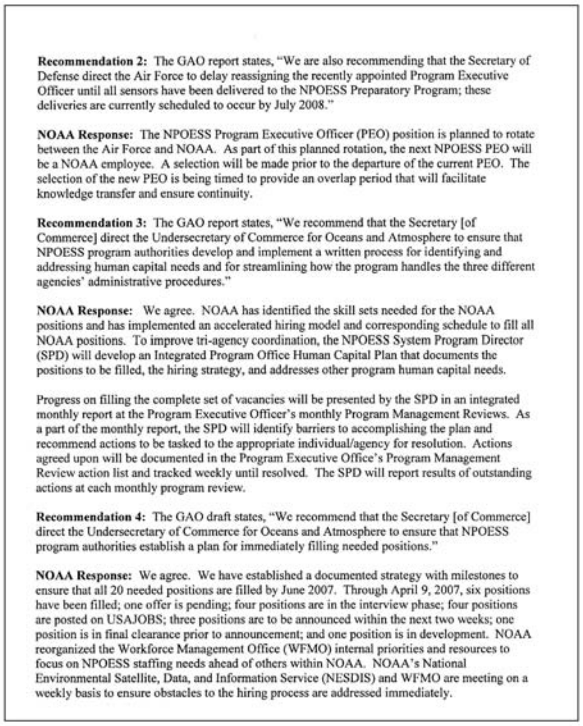
General Comments

The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review this draft report. The report acknowledges that the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program office has made progress in restructuring the satellite acquisition, but cautions that significant risks remain.

NOAA Response to GAO Recommendations

Recommendation 1: The GAO report states, "We are making recommendations to the Secretaries of Defense and Commerce and the Administrator of NASA to ensure that the responsible executives within their respective organizations approve key acquisition documents, including the memorandum of agreement among the three agencies, the system engineering plan, the test and evaluation master plan, and the acquisition strategy, as quickly as possible, but no later than April 30, 2007."

NOAA Response: NOAA agrees the four documents identified by the GAO are the key Acquisition Decision Memorandum (ADM) documents. NOAA has completed its initial review of these documents, concurred with them, and is prepared to sign-off on the documents, pending final review by the Air Force and NASA. NOAA will review any additional changes proposed by the Air Force or NASA before EXCOM coordination. Following completion of tri-agency coordination, the Program Executive Officer (PEO) will submit the final documents to the EXCOM and then to the Under Secretary of Defense (Acquisition, Technology and Logistics) after final Air Force and NASA clearance. Based on consultation with the Air Force, NOAA anticipates these documents being fully executed by July 2007. While later than GAO's recommended date of April 30, 2007, approval of these documents by July 2007 will not adversely impact program execution. The reason why these documents cannot be approved by April 30, 2007, is the length of the Department of Defense process for staffing such documents prior to submitting them for signature.



Recommendation 2: The GAO report states, "We are also recommending that the Secretary of Defense direct the Air Force to delay reassigning the recently appointed Program Executive Officer until all sensors have been delivered to the NPOESS Preparatory Program; these deliveries are currently scheduled to occur by July 2008."

NOAA Response: The NPOESS Program Executive Officer (PEO) position is planned to rotate between the Air Force and NOAA. As part of this planned rotation, the next NPOESS PEO will be a NOAA employee. A selection will be made prior to the departure of the current PEO. The selection of the new PEO is being timed to provide an overlap period that will facilitate knowledge transfer and ensure continuity.

Recommendation 3: The GAO report states, "We recommend that the Secretary [of Commerce] direct the Undersecretary of Commerce for Oceans and Atmosphere to ensure that NPOESS program authorities develop and implement a written process for identifying and addressing human capital needs and for streamlining how the program handles the three different agencies' administrative procedures."

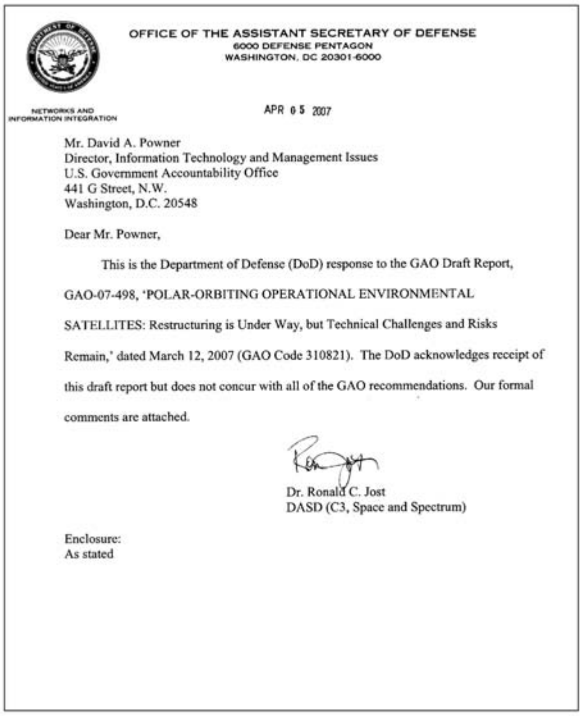
NOAA Response: We agree. NOAA has identified the skill sets needed for the NOAA positions and has implemented an accelerated hiring model and corresponding schedule to fill all NOAA positions. To improve tri-agency coordination, the NPOESS System Program Director (SPD) will develop an Integrated Program Office Human Capital Plan that documents the positions to be filled, the hiring strategy, and addresses other program human capital needs.

Progress on filling the complete set of vacancies will be presented by the SPD in an integrated monthly report at the Program Executive Officer's monthly Program Management Reviews. As a part of the monthly report, the SPD will identify barriers to accomplishing the plan and recommend actions to be tasked to the appropriate individual/agency for resolution. Actions agreed upon will be documented in the Program Executive Office's Program Management Review action list and tracked weekly until resolved. The SPD will report results of outstanding actions at each monthly program review.

Recommendation 4: The GAO draft states, "We recommend that the Secretary [of Commerce] direct the Undersecretary of Commerce for Oceans and Atmosphere to ensure that NPOESS program authorities establish a plan for immediately filling needed positions."

NOAA Response: We agree. We have established a documented strategy with milestones to ensure that all 20 needed positions are filled by June 2007. Through April 9, 2007, six positions have been filled; one offer is pending; four positions are in the interview phase; four positions are posted on USAJOBS; three positions are to be announced within the next two weeks; one position is in final clearance prior to announcement; and one position is in development. NOAA reorganized the Workforce Management Office (WFMO) internal priorities and resources to focus on NPOESS staffing needs ahead of others within NOAA. NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) and WFMO are meeting on a weekly basis to ensure obstacles to the hiring process are addressed immediately.

Appendix IV: Comments from the Department of Defense



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, DC 20301-6000

NETWORKS AND
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APR 05 2007

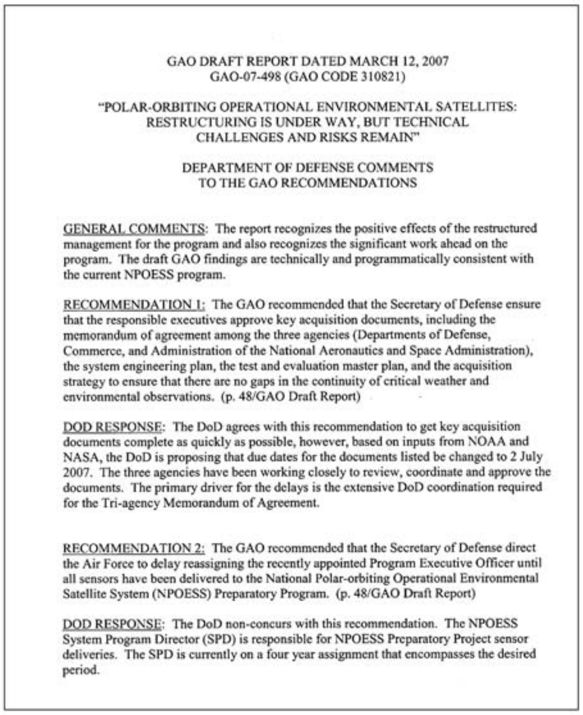
Mr. David A. Powner
Director, Information Technology and Management Issues
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Powner,

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-07-498, 'POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES: Restructuring is Under Way, but Technical Challenges and Risks Remain,' dated March 12, 2007 (GAO Code 310821). The DoD acknowledges receipt of this draft report but does not concur with all of the GAO recommendations. Our formal comments are attached.

Dr. Ronald C. Jost
DASD (C3, Space and Spectrum)

Enclosure:
As stated



GAO DRAFT REPORT DATED MARCH 12, 2007
GAO-07-498 (GAO CODE 310821)

"POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES:
RESTRUCTURING IS UNDER WAY, BUT TECHNICAL
CHALLENGES AND RISKS REMAIN"

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

GENERAL COMMENTS: The report recognizes the positive effects of the restructured management for the program and also recognizes the significant work ahead on the program. The draft GAO findings are technically and programmatically consistent with the current NPOESS program.

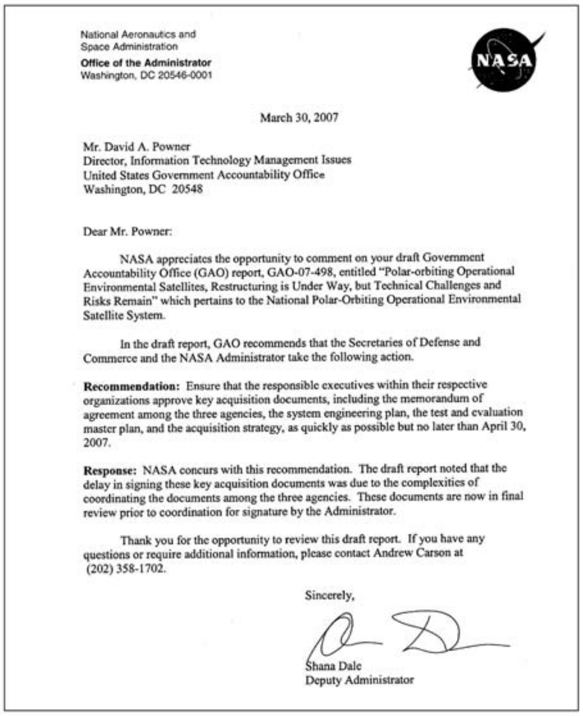
RECOMMENDATION 1: The GAO recommended that the Secretary of Defense ensure that the responsible executives approve key acquisition documents, including the memorandum of agreement among the three agencies (Departments of Defense, Commerce, and Administration of the National Aeronautics and Space Administration), the system engineering plan, the test and evaluation master plan, and the acquisition strategy to ensure that there are no gaps in the continuity of critical weather and environmental observations. (p. 48/GAO Draft Report)

DOD RESPONSE: The DoD agrees with this recommendation to get key acquisition documents complete as quickly as possible, however, based on inputs from NOAA and NASA, the DoD is proposing that due dates for the documents listed be changed to 2 July 2007. The three agencies have been working closely to review, coordinate and approve the documents. The primary driver for the delays is the extensive DoD coordination required for the Tri-agency Memorandum of Agreement.

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense direct the Air Force to delay reassigning the recently appointed Program Executive Officer until all sensors have been delivered to the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Program. (p. 48/GAO Draft Report)

DOD RESPONSE: The DoD non-concurs with this recommendation. The NPOESS System Program Director (SPD) is responsible for NPOESS Preparatory Project sensor deliveries. The SPD is currently on a four year assignment that encompasses the desired period.

Appendix V: Comments from the National Aeronautics and Space Administration



National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

March 30, 2007

Mr. David A. Powner
Director, Information Technology Management Issues
United States Government Accountability Office
Washington, DC 20548

Dear Mr. Powner:

NASA appreciates the opportunity to comment on your draft Government Accountability Office (GAO) report, GAO-07-498, entitled "Polar-orbiting Operational Environmental Satellites, Restructuring is Under Way, but Technical Challenges and Risks Remain" which pertains to the National Polar-Orbiting Operational Environmental Satellite System.

In the draft report, GAO recommends that the Secretaries of Defense and Commerce and the NASA Administrator take the following action.

Recommendation: Ensure that the responsible executives within their respective organizations approve key acquisition documents, including the memorandum of agreement among the three agencies, the system engineering plan, the test and evaluation master plan, and the acquisition strategy, as quickly as possible but no later than April 30, 2007.

Response: NASA concurs with this recommendation. The draft report noted that the delay in signing these key acquisition documents was due to the complexities of coordinating the documents among the three agencies. These documents are now in final review prior to coordination for signature by the Administrator.

Thank you for the opportunity to review this draft report. If you have any questions or require additional information, please contact Andrew Carson at (202) 358-1702.

Sincerely,

Shana Dale
Deputy Administrator

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

David A. Powner, (202) 512-9286, or pownerd@gao.gov

Staff Acknowledgments

In addition to the contact named above, Colleen Phillips, Assistant Director; Carol Cha; Neil Doherty; Nancy Glover; Kathleen S. Lovett; Karen Richey; and Teresa Smith made key contributions to this report.

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